Public Health Reports

VOLUME 56 MAY 2, 1941 NUMBER 18

IN THIS ISSUE

FEDERAL SECURITY AGENCY

UNITED STATES PUBLIC HEALTH SERVICE

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It contains (1) current information regarding the prevalence and geographic distribution of communicable diseases in the United States, insofar as data are obtainable, and of cholera, plague, smallpox, typhus fever, yellow fever, and other important communicable diseases throughout the world; (2) articles relating to the cause, prevention, and control of disease; (3) other pertinent information regarding sanitation and the conservation of the public health.

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UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1941

For sale by the Superintendent of Documents, Washington, D. C.

Price 5 cents. Subscription price $2.50 a year

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Public Health Reports

Vol. 56 • MAY 2, 1941 • *No. 18*

HOW HEALTH DEPARTMENTS FUNCTION WITH RESPECT TO SPECIFIC PROBLEMS [1]

By J. O. Dean, *Passed Assistant Surgeon*, and Evelyn Flook, *United States Public Health Service*

INTRODUCTION

One of the most challenging aspects of public health administration is the lack of uniformity with which health departments, organized along basically similar lines, function in respect to specific problems. Unfortunately, the extent to which this chaotic state of disagreement exists in the various realms of public health work is not fully appreciated. It is believed, however, that information obtained from the records of three representative rural health departments and analyzed by this office is sufficiently impressive to awaken public health administrators to the desirability of critically evaluating the various prevailing practices before any are applied locally. That the numerous, widely differing policies now employed in solving any common problem cannot be equally effective is obvious.

In two previous articles of this series,[2] these three representative rural health departments, designated as A, B, and C, were analyzed as to organization, volume and distribution of services, and the extent to which various staff members coordinate their activities. This paper presents an analysis of their practices in handling outstanding public health problems.

The study is based upon population units of approximately 26,500 in County A, 55,000 in County B, and 41,000 in the rural sections of County C. The county seat (population 85,000) of the last named was excluded because it has its own city health department.

The greater part of the study area is rural and agricultural, although about one-half of the population resides in communities unincorporated but located in part on the outskirts of a city. Consequently, the

[1] From the Division of Public Health Methods, National Institute of Health, in cooperation with the Division of Domestic Quarantine.

[2] Mountin, Joseph W., and Flook, Evelyn: The scope of personal service rendered by three representative health departments. The Health Officer. November 1939.

Dean, J. O., and Flook, Evelyn: Neglected opportunities for teamwork in county health department practice. Pub. Health Rep., 55: 573 (April 5, 1940).

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public health problems involved come from both rural and, in all but name, urban living conditions.

The three counties have other similar features. The population is predominantly white, the highest Negro representation being 19 percent in County A. Each of the counties is above the average of its State in wealth, although County A is below the average for the country as a whole. All three have about the same type of health department. From these characteristics in common one would be inclined to look for a decided similarity in health department policies and procedures for the handling of specific health problems. On the contrary, the striking dissimilarity found in respect to outstanding public health problems is marked enough to warrant extensive consideration.

CONTROL OF COMMUNICABLE DISEASE

Programs adopted by the three counties for the control of communicable disease represent the first major difference found. Even such universally recommended procedures as punctual investigation by the health department of reported cases, isolation of patient and contacts, and provision of immunity against certain specific conditions were not followed with any noticeable degree of comparability. The need of a common policy with regard to selecting communicable disease cases to be visited is well illustrated by the striking differences observed. Health department supervision of cases received little emphasis in County B, as is apparent from the fact that only 90 of the 1,497 cases of known communicable illness were visited by health department personnel. (See table 1.) Diphtheria, scarlet and typhoid fevers, and such less frequent diseases as undulant and Rocky Mountain spotted fevers were the conditions regularly included in the health department's visiting program. Indeed, it would appear that even among these, only about three-fifths of the known diphtheria and scarlet fever cases in this county actually received health department attention. Whenever dairy farms were affected, however, strict supervision was maintained.

County C's visiting policy offers a marked contrast to that of County B. In all, 3,786 cases of communicable disease were visited during the study year by some representative of the health department in County C. Conditions listed for visiting were not restricted to those of a relatively serious nature as was the case in County B. In fact, visits were made to 98 percent of the aggregate number of communicable disease cases which came to the attention of County C's health department.

TABLE 1.—*Number of cases of certain acute communicable diseases known to the health departments of three selected counties and number of those cases visited by some member of the health department staff*

Disease	County A		County B		County C	
	Cases known to the health department	Cases visited	Cases known to the health department	Cases visited	Cases known to the health department	Cases visited
Total for the diseases listed	1,245	227	1,497	90	3,873	3,786
Chickenpox	27	6	66		119	105
Conjunctivitis	[1] 5	5	[1] 1	1	[1] 26	26
Diarrhea and dysentery	32	8	12		[1] 2	2
Diphtheria	18	17	37	21	90	82
Erysipelas	(1)		1		[1] 1	1
German measles	[1] 1	1	6		1	
Influenza	78	1	78		9	9
Intestinal parasites	[1] 9	9	(1)		[1] 2	2
Malaria	1		1	1	[1] 6	6
Measles	803	85	962	10	3,291	3,245
Mumps	40	16	63		[1] 7	7
Pneumonia	81	12	99		[1] 8	8
Poliomyelitis	2	1	1		3	3
Rocky Mountain spotted fever	6	6	8	2	1	1
Scarlet fever	50	43	84	51	140	127
Septic sore throat	[1] 2	2	2			
Smallpox	1	1				
Typhoid and paratyphoid fever	9	6	3	3	15	13
Undulant fever			3	1	1	
Whooping cough	80	8	70		151	149

[1] Not reportable—discovered in the nurse's routine visiting or because health department aid was requested.

County A pursued an intermediate course in the matter of visiting communicable disease cases. The list selected for intensive control measures was limited, but a concentrated effort was made to visit all cases of those particular conditions. Records indicate that the organization met with considerable success in attaining this goal. A total of 227 cases were brought under health department surveillance.

Further evidence of diversity in the method of communicable disease control employed by the three counties is found in the type of service which was recorded for each family. According to table 2, the chief purpose of health department contact in County C was to impose regulatory measures upon the household. Under this heading are included isolating, quarantining, placarding, or the excluding from school of cases, contacts, or suspects. On the other hand, these control measures appear to have been regarded as relatively unimportant in County B. Investigation of reported cases represented the most frequent purpose for visiting communicable disease situations in this county. This difference in quarantine policy is even more accentuated when it is recalled that most of the illnesses visited by the health department in County B were of the graver types. The practice of County A's health department with regard to quarantine seems to represent middle ground between that of the other two counties.

TABLE 2.—*Type of service rendered by health department personnel of three selected counties on the first visit to households seen solely for communicable disease*

Type of service rendered	Number of households which received designated service on first visit of health department personnel		
	County A	County B	County C
Total [1]	147	[2] 101	1,775
Impose restrictive measures	64	16	1,540
Diagnose condition or give medical treatment	30	5	38
Give nursing instructions concerning communicable disease	14	12	23
Investigate reported case	14	46	99
Collect laboratory specimens or cultures	7	10	15
Do bedside nursing	5	2	3
Terminate restrictive measures	3	1	2
Conduct typhoid investigation	2		
Inspect condition of child in school		1	
Investigate school absenteeism			23
Transfer patient to hospital			4
Type of service unknown	8	8	28

[1] Seventeen households of County A and 4 of County C were omitted from this tabulation because the health department service rendered was not exclusively for communicable disease.
[2] Only 90 cases were involved in these 101 households. Presence of contacts accounts for visits to those homes without cases.

County B provided diagnosis and/or medical treatment less frequently that did either of the other areas. Nursing instructions concerning care of communicable disease patients were given for a higher proportion of the situations visited in A and B than in C. In no county was bedside nursing an appreciable part of the control program.

An instance of striking diversity in classification by the three organizations lies in the proportion of cases reported as having complications. Ninety-five percent of the cases visited by health department workers of County C were placed in this category, whereas only one-fourth of those visited in County B and one-twelfth in County A were so classified. These figures no doubt reflect, in some measure, the disease receiving predominant health department attention in each county, for it is recognized that complications are more apt to develop from some diseases than from others. In view of the extreme differences, however, the variance reported obviously represents, in part at least, different interpretations of the term "complications."

At the time of this study the Committee on Administrative Practice [3] recommended two release cultures as standard laboratory procedure in the supervision of both diphtheria and typhoid fever cases. With a goal so definitely stated it seems odd that laboratory service provided by the three health departments was almost exclusively for diphtheria, and even for this disease no regularity of practice was demonstrated, either in proportion of patients cultured or in

[3] The Committee on Administrative Practice. Appraisal Form for Rural Health Work. American Public Health Association, New York, 1932.

number of cultures made per patient. Throat or nose and throat cultures were taken for all but one diphtheria case visited in County A, for seven-eighths of the number supervised in County C, and for more than one-half of those under observation in County B. In each county the number of such cultures made per patient fell somewhat short of standard practice. According to the records, the organizations also varied in their methods of making diphtheria cultures. Health Department A reported throat cultures only; Health Department B stated that all cultures were from both nose and throat and Health Department C reported that its practice varied. None of the departments met standard requirements for the release of typhoid fever cases. The number of communicable disease patients for whom immune serum was supplied by the health department was inconsequential. When such service was provided it was usually for cases recorded as having complications.

Absence of a common pattern of control was not restricted to supervision of cases. Procedures followed with respect to contacts, suspects, and carriers also differed widely. Although the aggregate number of such persons visited was approximately the same in each county, the variations were marked in relation to the number of cases admitted to service. From this standpoint, Health Department C paid little attention to contacts, suspects, or carriers. On the contrary, Department B placed greater emphasis upon such control than upon supervision of cases. Diphtheria, scarlet fever, and typhoid fever represent the particular conditions for which supervision of contacts, suspects, or carriers was given in all areas.

Still another dissimilarity in operation of the three health departments is manifest in the duration of the supervisory periods maintained over households with communicable disease. Table 4 shows that less than one-half of the situations supervised by Department B received more than a single visit, whereas in County C 75 percent were observed for an extended period varying from 1 day to more than 3 weeks. Health Department A occupied an intermediate position. Not only did a higher percentage of situations in County C receive extended supervision, but the sustained period of observation was also longer in this county. The median length of time between the first and last visits of the health department was 11.3 days in County B, 16.3 days in County A, and 18 days in County C. These medians, of course, are based upon only those situations which received more than one visit.

TABLE 3.—*Number of cases of certain acute communicable diseases visited by the health departments of three selected counties, and number of additional persons visited as contacts, suspects, or carriers of the specified diseases*

Disease	County A		County B		County C	
	Cases	Contacts, suspects, and carriers	Cases	Contacts, suspects, and carriers	Cases	Contacts, suspects, and carriers
Total for the diseases listed	227	183	90	207	3,786	177
Chickenpox	6				105	9
Conjunctivitis	5		1		26	
Diarrhea and dysentery	8				2	
Diphtheria	17	58	21	93	82	66
Erysipelas					1	
German measles	1					
Influenza	1				9	
Intestinal parasites	9	3			2	
Malaria			1		6	13
Measles	85	8	10	1	3,245	31
Meningitis						1
Mumps	16	3			7	1
Pneumonia	12			1	8	
Poliomyelitis	1	1			3	1
Rabies						7
Rocky Mountain spotted fever	6	2	2		1	
Scarlet fever	43	66	51	104	127	22
Septic sore throat	2					
Smallpox	1	8				
Typhoid and paratyphoid fever	6	31	3	8	13	23
Undulant fever			1			
Whooping cough	8	3			149	3

TABLE 4.—*Distribution of households visited for the control of communicable disease by health department personnel of three selected counties according to length of the supervisory period maintained by the health department*

Period of supervision	County A		County B		County C	
	Number of households supervised for specified period	Percent of households supervised for specified period	Number of households supervised for specified period	Percent of households supervised for specified period	Number of households supervised for specified period	Percent of households supervised for specified period
Total	164	100.0	101	100.0	1,779	100.0
No extended period (1 visit only)	70	42.7	57	56.4	438	24.6
1–6 days	16	9.8	17	16.8	56	3.1
7–12 days	16	9.8	7	6.9	280	15.8
13–18 days	24	14.6	2	2.0	334	18.8
19–24 days	24	14.6	5	5.0	336	18.9
Over 24 days	14	8.5	13	12.9	335	18.8

Service for the situations which received no return visits was predominantly the investigation of reported cases and the placing of standard restrictive measures upon the household. Where the interval of time between the first and last visit was prolonged the last visit was chiefly for the purposes of terminating restrictions, giving instructions concerning communicable diseases, or checking up on patients after expiration of the quarantine period. The last-named purpose applied to only one department, since only in County C was attention extended beyond the termination of quarantine.

Most States require that all known cases of certain communicable diseases shall be reported by local authorities to the State health department. When actual names of persons attended by health department personnel for selected conditions [4] were compared with the names of those reported to the State organization, it was found that 98 percent of the cases served by Health Department B were reported to the State; in County A only 55 percent of a similar group were reported; and in County C the corresponding percentage dropped to 26. Thus it is evident that considerable variation existed among the three departments with regard to thoroughness of reporting—a further indication of the absence of a singleness of regimen in communicable disease control activities. It should be noted that in each area the comparatively serious diseases, such as diphtheria and scarlet fever, were more consistently reported to the State than those of minor character.

CONTROL OF TUBERCULOSIS

Conformity to a single policy is as nonexistent in the tuberculosis programs adopted by the health departments under consideration as in their activities for control of the acute communicable diseases.

The tuberculosis file of Health Department B was compiled from disease and death reports of private physicians, cases discovered in the conduct of chest clinics, referred reports of some of the sanatoria on discharge of patients, reports of welfare workers or teachers, and requests for health department aid from tuberculosis patients or their relatives. County A's register was composed almost entirely of cases reported by private physicians and those discovered in the course of clinic examinations. The file of County C was made up of patients referred by physicians to the out-patient department of the sanatorium for confirmation of diagnosis. Because of this single source of information it is not surprising to find that all of the cases known to the authorities of County C were examined during the study year, while only two-thirds of those registered in County B and less than one-half of those in County A received examination.

In County C, where sanatorium facilities were available within the area, the case was usually hospitalized. While it is true that neither County A nor County B had local tuberculosis hospital facilities, residents of both counties were eligible for admission to their respective State sanatoria. The health departments of these two counties obtained hospitalization for relatively few cases, as the figures in table 5 indicate. Here it is revealed that only 15 persons, or 18 percent of the total cases officially recorded in County A at the end of the year, and 52 persons, or one-fourth of the total cases on County B's roster, received sanatorium care during the study interval. On

[4] No comparison was attempted for measles cases, because of the volume encountered.

the contrary, 53 persons, over one-half of the diagnosed cases under supervision of Department C, were hospitalized within the same period of time.

The control activities of County C may be described as entirely a sanatorium-sponsored program inasmuch as ambulatory cases, symptomatic suspects, and contacts, as well as in-patients, were given tuberculin tests and X-ray and physical examinations by members of the sanatorium staff. Out-patients of the foregoing classes were usually referred to them by the attending physician.

X-ray as a diagnostic technique was more consistently employed in County C than in Counties A and B. (See table 5.) In the former area an X-ray examination was made of more than three-fourths of the 265 persons who received any type of examination (including complete tuberculin test,[5] X-ray, clinic examination, and examination by private physician), while in County A less than one-third and in County B less than one-fifth of the persons examined had the advantage of this aid to diagnosis. The variation found reflects another difference in policy. Although the clinician of County C reported that an X-ray picture was made for over half of the cases and for 90 percent of the contacts and suspects examined, clinicians of Counties A and B used this device only when physical findings made a diagnosis questionable. However, these health departments did make a concentrated effort to secure an X-ray examination for all child contacts who had positive reactions to tuberculin tests. In this policy they were strikingly successful.

TABLE 5.—*Distribution of tuberculosis clientele registered by the health departments of three selected counties according to first designation of patient during the study year and the type of service received*

Type of service	Number and percentage of cases and contacts who received specified services for tuberculosis											
	County A				County B				County C			
	Cases		Contacts or suspects		Cases		Contacts or suspects		Cases		Contacts or suspects	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
All types considered [1]	83	------	428	------	215	------	1,097	------	90	------	481	------
No health department service	4	4.8	198	46.3	10	4.7	525	47.9	4	4.4	297	61.7
Nursing service	75	90.4	202	47.2	185	86.0	554	50.5	26	28.9	84	17.5
Examination of any kind	34	41.0	116	27.1	147	68.4	345	31.4	90	100.0	175	36.4
Tuberculin test	------	------	40	9.3	14	6.5	209	19.1	3	3.3	72	15.0
X-ray	7	8.4	38	8.9	13	6.0	77	7.0	46	51.1	158	32.8
Clinic	16	19.3	112	26.2	96	44.7	163	14.9	50	55.6	139	28.9
Private physician only	12	14.5	1	.2	32	14.9	5	.5	------	------	------	------
Sanatorium care	15	18.1	------	------	52	24.2	5	.5	53	58.9	10	2.1

[1] Some individuals received several types of service.

[5] A completed tuberculin test is one for which the reaction was read.

While the records of Health Department C indicated that hospitalization of the case was concentrated upon in that county, the corresponding agencies of Counties A and B appear to have subscribed to the policy of making home nursing visits to all families who were known to have been exposed to infection. The primary purpose of nursing service in County B was to promote examination of family contacts. Upon her initial call the nurse endeavored to arrange for a return visit with the health officer for the purpose of tuberculin testing all child contacts. Those having positive reactions were then given X-ray examinations at the general hospital in the county as a preliminary procedure to chest clinic admission. Frequently it was necessary for the nurse to furnish patients transportation to the clinic. Subsequent instructive visits, after the goal of contact examination was reached, included such service as advice concerning hygiene, diet, or precautionary measures; interpretation of clinic reports; and instructions concerning sanatorium admission and care. There was no fixed interval of time to determine subsequent visits, and no routine practice was followed. Generally, active cases of tuberculosis not under the supervision of a private physician were visited about once every three months.

The nurse of County A also attempted to visit all families eligible for tuberculosis service, but the fact that less than one-half of these households received more than a single visit raises doubt, from the standpoint of tuberculosis control, as to the effectiveness of her visiting program. Her attention was concentrated upon the case in the household rather than upon the contacts, the primary purpose of her visit being to instruct the patient in methods of caring for himself and in precautions designed to protect other members of the family. Some attempt was made to stimulate interest in examination of contacts, but this was usually incidental to attention to the case. Only when family members exhibited suspicious symptoms of disease did the nurse assiduously urge clinic attendance.

Inspection of the data reveals that the health departments of Counties A and B closely adhered to their policies of visiting all families known to have been exposed to tuberculosis. Nursing service was rendered to 91 percent of the 140 families appearing on the register of County A and to 88 percent of the 294 families constituting County B's tuberculosis file. The records also disclose that, in practice as in policy, the nursing staff of County A was customarily concerned only with the family member diagnosed as a case or exhibiting definite symptoms of the disease, for nursing service was recorded for 90 percent of the cases and nearly one-half of the contacts in this area. In County B, where the nurse was supposed to check upon the condition of all contacts in the home, actual practice differed

from the stated policy of the jurisdiction. Here, as in County A, relatively more attention was devoted to cases than to contacts as nursing service was recorded for 86 percent of the cases and 50 percent of the contacts known to the health department.

Nursing service held a minor position in County C's plan of tuberculosis control. In this county, only one-third of the 184 families known by the health department to have been exposed to infection were visited by a public health nurse. Persons attended embraced slightly more than one-fourth of the cases and one-sixth of the contacts. The fact that so few tuberculosis patients received nursing service in County C becomes increasingly significant when it is realized that the population load per nurse was smaller here than in either of the other areas under discussion.

OPERATION OF VENEREAL DISEASE CLINICS

Only two of the counties maintained clinics for the diagnosis and treatment of venereal disease. One of these organizations was considerably larger than the other. The clinic of County C was visited by 1,672 persons, but only 769 received treatment. Corresponding figures for County B's clinic were 167 and 108. McKneely and Pearson[6] in their study of operating principles of these two clinics found both of them to be ineffective in the following respects: (1) Lack of basic data for gaging the extent of the venereal disease problem within the localities involved, (2) limited scope of service, (3) desultory extraclinic investigation, (4) incomplete recording of significant information, (5) failure to utilize appropriate diagnostic aids, and (6) treatment which disregarded individual differences.

According to the investigators, neither health department could even estimate the prevalence or incidence of venereal diseases within its jurisdiction; therefore it was impossible to understand the problem as a whole. Emphasis was placed upon the control of syphilis, with almost no regard for the problem of gonorrhea. Little relationship existed between the maternity clinics and those set up for venereal disease. Failure to investigate the source of infection and all contacts of the patient was particularly striking. In both clinics the lapsed attendance of patients was also marked.

The clinic of County C maintained a fairly uniform method of treatment, prescribed by the State health department, which specified definite pauses in the course of treatment. The clinic of County B subscribed to no predetermined system but, in actual practice, followed the plan of giving continuous treatment rather than of permitting rest periods.

[6] McKneely, Thomas B., and Pearson, Kay: Does this describe your venereal disease clinic? Venereal Disease Information, Vol. 18, June 1937.

MATERNITY SERVICE

According to table 6, the health department furnished maternity service, almost exclusively nursing in character, to 10 percent of the maternity population[7] in County A, 15 percent in County B, and 12 percent in County C. In all three areas, most of the maternity patients served by the health departments were in the poor or very poor economic classification.[8] Race was of minor importance in the selection of cases to receive public service in County C. The other two organizations observed different practices in this respect. Health Department B concentrated a large portion of its service on Negro patients. Health Department A, on the other hand, favored white mothers as recipients of maternity attention.

TABLE 6.—*Number of births, estimated number of maternity cases,[1] and proportion of cases served by the health department during the study year*

County	Number of births	Maternity cases		
		Estimated number	Served by health department	
			Number	Percent
A	435	761	80	10.5
B	993	1,738	270	15.5
C	902	1,578	183	11.6

[1] For the purposes of this analysis "maternity population" is defined as follows: Mothers who gave birth to live or stillborn infants during the study year, plus the proportionate number that are estimated to have become pregnant during the last 9 months of the study interval.

Not all persons listed on the health department's maternity rosters were given medical and nursing supervision throughout the maternity cycle. Some of them received antepartum service only, some, postpartum service only, and a few, delivery service only. On the other hand, certain patients received both antepartum and postpartum supervision, while others were assisted at delivery and received either antepartum or postpartum care. More patients in Counties A and C received antepartum than postpartum service. This situation was reversed in County B where one of the objectives of maternity service was the delivery of birth certificates by nurses. Always on this occasion a postpartum visit was recorded by the nurses.

Patients came to the attention of the health department through various channels. In Counties A and C patients and relatives were the most frequent sources of information (table 7). The fact that about 40 percent of the health department maternity patients in these

[7] For the purposes of this analysis "maternity population" is defined as follows: Mothers who gave birth to live or stillborn infants during the study year, plus the proportionate number that are estimated to have become pregnant during the last 9 months of the study interval.

[8] Those who have the bare necessities of life, but no luxuries, are regarded as poor, while those who lack sufficient food, shelter, and clothing are classified as very poor.

two counties sought aid themselves would seem to indicate that the department had succeeded in bringing to the attention of prospective mothers the services which a nurse might render during pregnancy. The chief source of information in County B was the birth certificate. Naturally cases found in this manner could not be given any antepartum service.

Antepartum care consisted chiefly of nursing supervision. The average number of home visits made to each patient ranged from 2.1 in County B to 3 in County C. Failure to find cases early is one factor that prevents the nurses from following the recommended practice of continuous supervision of prenatal cases. Very few patients were seen during the first trimester of their pregnancy; those found in the second and third trimesters were almost equally divided as to number. Proportionately more cases were discovered early in County A than in either other area; County B ranks least favorably from this standpoint. However, relatively more patients availed themselves of clinic service in the latter jurisdiction than in County C. No maternal hygiene clinic was maintained in County A; however, clinic facilities in adjoining jurisdictions were utilized to some extent. Although clinic service was not widely distributed in any county, those patients who attended had been urged to do so by the nurses during home visits.

TABLE 7.—*Number and percentage of maternity patients served by the health departments of three counties according to source of first information*

Source of first information	County A		County B		County C	
	Number	Percent	Number	Percent	Number	Percent
All sources	80	100.0	270	100.0	183	100.0
Patient or relative	32	40.0	19	7.0	74	40.4
Neighbor	6	7.5	19	7.0	23	12.6
Visit to another member of family	10	12.5	52	19.3	26	14.2
Social and other agencies	17	21.3	41	15.2	31	16.9
Midwife	2	2.5	16	5.9	2	1.1
Physician	4	5.0	9	3.4	3	1.6
Birth certificate			63	23.3	8	4.4
Other	9	11.2	51	18.9	16	8.8

Throughout the program there was evidence of lack of planning in the service rendered. Patients with recorded symptoms of toxemia received more visits on the average than did the nontoxic patients, but many of those with symptoms of toxemia failed to receive supervision through the months of pregnancy following the first visit. Frequently even those patients with symptoms of toxemia who were subsequently visited did not receive a return visit as early as patients free from toxic condition. Patients found early in their pregnancy received more visits than those found late, but there was no evidence that a planned program of visiting was being followed. More than half of the postpartum patients were not visited during the period that a nurse's services are most needed, namely, the lying-in period.

SANITATION ACTIVITIES

Sanitation officers and their part-time assistants (the latter provided through cooperation of the work relief agency) were almost entirely responsible for sanitation services, except that the health officers were called upon in matters where policy was involved. Milk and water sanitation and privy-building projects represented outstanding activities during the course of the study year. Inasmuch as work of the relief sanitarians cannot be converted into the equivalent of full-time performance, only services of the regular sanitation officers will be subjected to analysis in this discussion. Not only was the proportion of all homes which were inspected by the sanitation officer higher for Counties A and B than for County C, but the aggregate volume of service reported for the first two counties was also higher than for the third. However, the emergency privy-building program was much more extensive in County C than in A or B. Supervision of this work absorbed much of the sanitation officer's time. In the distribution of service all three departments favored residential premises over those which were nonresidential in character. Respectively, 1,440, 1,240, and 308 residential visits were reported during the year by the three sanitation officers.

Lack of uniformity is noted in the concentration of sanitation service rendered by the three health departments. In County C 28 percent of all homes visited were located in the open country. In Counties A and B, on the other hand, 40 and 45 percent, respectively, of all residential premises visited by the sanitation officers were classified as rural. This proportion represents particular emphasis upon rural sections in County B, as only 20 percent of all families residing in this jurisdiction are classified in the rural category. Such marked concentration of sanitation service to rural homes is due, in great measure, to the milk and dairy program which was receiving much attention from the health department during the study year. Of the 343 rural premises visited, 148 were dairy farms. Inspection of these milk-producing premises to determine whether regulations were being complied with was the sanitation officer's main objective in visiting them. Installation of approved type privies was often necessary before requirements of the milk ordinance could be met. Most of the actual building was done by relief workmen, but the sanitation officer assisted in the preliminary survey and designated the premises that should receive new privies.

In County B residential visits were divided about proportionately between white and colored families. In Counties A and C, however, white families were favored.

Perhaps one of the most striking differences in the activity of the three sanitation officers is revealed by the sources of call which stimu-

lated their premises visits. (See table 8.) In County A the sanitation officer himself initiated service to more than three-fourths of the premises which he visited. Twelve percent of the residences visited in this county were inspected at the request of the occupant of the premises. Plumbers, contractors, carpenters, and well-diggers constituted practically the only other institutors of service. The situation in County C was directly opposite to the one just described. Here the sanitation officer appears to have initiated relatively little service himself; instead, most of the visits were made on invitation.

TABLE 8.—*Distribution of premises visited for the first time by the sanitation officers of three selected counties in response to a specified source of call*

Source of call	Premises visited in response to each source of call					
	County A		County B		County C	
	Number	Percent	Number	Percent	Number	Percent
All sources	709	100.0	817	100.0	200	100.0
Sanitation officer	559	78.9	263	32.2	40	20.0
Occupant of premises	84	11.9	34	4.1	45	22.5
Neighbor	8	1.1	76	9.3	15	7.5
Plumber, contractor, or well-digger	45	6.3	3	.4	28	14.0
Emergency relief workmen			414	50.7	35	17.5
Local or county official	7	1.0	14	1.7	37	18.5
Other	6	.8	13	1.6		

One-half of the premises inspected by the sanitation officer of County B were visited with emergency relief workmen in connection with the sanitary survey of the county, to which reference has already been made. One-third of the premises were visited through interest of the sanitation officer alone. There was less evidence of sanitary improvement being initiated by premises occupants in County B than in either of the other counties. Conversely, neighbors made relatively more complaints, a condition probably resulting from greater concentration of the population there than in either of the other areas. The complaints usually arose from nuisances such as hog farms, open wells, rubbish piles or refuse heaps, dead animals, or objectionable pets or poultry.

SUMMARY

Service records of three health departments similar in population served and in general administrative organization reveal a striking lack of uniformity in their methods of handling specific health problems. Diversity of policy is demonstrated by the manner in which the several health units operated for the control of communicable disease, tuberculosis, and the venereal diseases, and for the provision of maternal hygiene and sanitation services. Whereas one department favored supervision of only such serious transmissible illnesses as diphtheria and scarlet or typhoid fever, another made no selection as

to type but attempted to visit all communicable disease cases brought to the department's attention. In one county the restriction of cases and contacts was emphasized; in another, little effort was made to quarantine cases of even the graver kinds of illness. Repeat visits characterized the policy of one department; in contrast, another was likely to make but a single visit.

The three organizations showed marked variation in the number of tuberculosis patients brought within the scope of health department activity. They also differed as to the type of service stressed. Hospitalization was the primary approach of one department; the second relied upon repeated clinic examinations; the third, in addition to clinic service, emphasized field visits.

Only two of the health departments maintained clinics for the diagnosis and treatment of venereal disease. Approximately ten times as many persons visited one of these clinics as were served by the other. A method of treatment prescribed by the State health department was followed by one venereal disease unit, but the other subscribed to no predetermined system. Rest periods were recommended by one, continuous treatment by the other.

That no common program of maternal hygiene has been adopted is evident from the following circumstances: Uniformity was lacking in the selection of patients according to race. Maternal hygiene clinics were maintained by only two of the three counties. Antepartum care was stressed in two counties, postpartum visits in the third. Finally, variation existed among the departments from the standpoint of discovering patients early in their pregnancy.

Although some planning was evident in all three sanitation programs, comparable features were not covered. In two counties, services to residential premises were frequently initiated by the sanitation officers; in the third it was the custom to make inspections only when a request came for the sanitation officer to call. Furthermore, different bases were used in the three areas for selecting premises to receive sanitation measures. One department concentrated upon service to homes located in towns and villages, while the other emphasized improvement of sanitary conditions in rural homes. White families were favored in two counties, but race of the occupant had no influence upon the premises inspected in the third.

DISCUSSION

Examples of more extremely varied methods of handling the same type of health problems could scarcely be found than those portrayed as existing in these three counties. When it is recalled that the counties were quite similar in type of population, in organization of the health department responsible for each program, and in most other respects, the wide differences in procedures become even more

significant. They indicate either conspicuous disagreement among the three health officers as to the most effective methods of rendering public health services, or a failure to ascertain the most effective procedures and put them into practice.

If such differences are typical of other county health departments, and it is believed that they are, they definitely suggest the need for a critical evaluation of the activities of county health department personnel in order that ineffective effort may be diverted into productive action. Certainly the extremely different procedures followed by these three counties could not have been equally effective; in fact, the most effective procedures may not have been used in any of the counties. In view of this, it is urgent that public health workers give more consideration to the success of their efforts so that every dollar spent for public health may purchase maximum health for the community.

BACTERICIDAL EFFECT OF THE PARAFFINING OF PAPERBOARD USED FOR PAPER MILK CONTAINERS [1]

By FREDERIC J. MOSS, *Sanitary Engineer*, ROBERT C. THOMAS, *Associate Milk Specialist*, and MILDRED K. HAVENS, *Senior Medical Technician, United States Public Health Service*

INTRODUCTION

The paper container for fluid milk is not of as recent origin as is generally believed. Winslow (*1*) mentioned a study of the paper bottle by Dr. A. H. Stewart which was reported in Sanitation for December 6, 1905, and stated that the latest departure in the way of a milk bottle was the single-service paper milk bottle sold by the Renno Case Company of Philadelphia. In the annual report of the United States Public Health and Marine Hospital Service for 1908, reference is made to an opinion by the Chief, Division of Chemistry, Hygienic Laboratory, relative to paraffined milk containers. This opinion was given in response to an inquiry from the Liquid Paper Package Company, Washington, D. C. In 1908, one of the Canadian farm journals (*2*) contained a discussion of the advantages and disadvantages of paper milk bottles. In 1909, Winslow (*3*) reported a single-service milk container of woodpaper made and invented by G. W. Maxwell of San Francisco and in use at that time by dairymen in Los Angeles.

Despite its early introduction, however, the paper milk container did not come into extensive commercial use until about 1929–30. Introduced at that time in New York City, it is now being used in a number of the larger as well as in many smaller cities in this country. In most cases the use of the paper container has been confined to the wholesale distribution of milk, that is, for milk to be sold through

[1] From Milk Investigations, Division of Public Health Methods, National Institute of Health.

stores and restaurants. Recently, however, two of the larger milk companies in New York City have started the use of 2-quart paper milk containers for retail delivery (*4*).

PARAFFINING OF PAPER MILK CONTAINERS

The various single-service containers used for fluid milk were classified by Tracy (*5*) into three general types, namely, "those prefabricated and requiring a special filling machine; those prefabricated but not requiring a special machine for filling, it being possible to use the regular glass bottle filling machine; and finally, those that are formed and paraffined in the dairy just before filling, requiring, of course, a special machine for the purpose." Irrespective of the type, however, practically all of the single-service paper containers are paraffined after being formed.

Tanner (*6*) gave the following purposes for the paraffin coating of paper milk containers:

1. Contributes greatly to strength and rigidity.
2. Helps to secure a hermetical seal.
3. Improves the appearance of the bottle by causing a more brilliant finish.
4. Inert to attack by ordinary bacteria.
5. Free from color, taste, and odor.
6. Available with various melting points.
7. Practically free from microorganisms.
8. Good waterproofing surface.
9. Prevents microorganisms from entering the milk.
10. Contributes to a sterile container.

Methods used for the bactericidal treatment of glass milk bottles are not generally applicable to the bactericidal treatment of paper milk containers. Since practically all paper milk containers are paraffined, the present study was made to obtain data useful in determining temperature and time combinations of paraffining that would provide adequate bactericidal treatment of the surfaces of these containers.

For the paraffining of paper containers in this country, the temperature of the paraffin is usually in the range of 160°–180° F. With these high paraffin temperatures, it would seem reasonable to expect that the exposure time need be of only brief duration to insure a sterile container. Some investigations, however, have indicated that the necessary exposure time is probably not as brief as had been anticipated.

Tanner (*6*) reported an investigation in which strips of paperboard inoculated with *Esch. coli* were subjected, after drying, to heating in

both water and paraffin. None of the strips which were heated in water at a temperature of 168° F. carried living cells. Those heated in paraffin at 168° F. and 190° F. for 12, 15, 17, 20, and 25 seconds showed almost uniform presence of viable cells of *Esch. coli*.

Prucha (*7*) studied the bactericidal effect of paraffining of paperboard both in the milk plant and in the laboratory. In the laboratory study, he used strips of paperboard which had been dipped in a suspension of *B. prodigiosus*. After drying, they were paraffined at different temperatures for varying lengths of time. A table giving the results of a typical run showed that of the six strips of paperboard examined at each temperature and time combination studied, the bacteria were all killed in 20 seconds at 212° F.; in 30 seconds at 200°, 190°, and 180° F.; in 45 seconds at 170° F.; but were not killed in 1 minute at 160° F. Prucha concluded that when the containers were protected in the manner he suggested, paraffining the containers at 185° F. for 30 seconds would result in a practically sterile container, but that entire dependence on paraffining to insure complete sterility of the container might not be sufficient.

Investigations (*8*, *9*, *10*) have shown that microorganisms suspended in water-free substances such as fat, paraffin, oil, and glycerin are not readily killed by the sterilizing action of heat. In fact, in the absence of water, the sterilizing action obtained by heating in glycerin or oil was found to correspond to that of dry air (*9*, *10*).

ESCH. COLI AS A TEST ORGANISM

In experiments on the bactericidal effect of paraffining of paperboard, *Esch. coli* has sometimes been used as a test organism and the work has been directed toward obtaining the temperature and time combinations required to produce sterility. Cultures of *Esch. coli*, however, vary in their thermal resistance (*11*). If the culture of *Esch. coli* used is more or is less heat-resistant than the most heat-resistant pathogen transmissible through milk supplies, then the temperature and time combinations required to produce sterility will be more or less stringent, respectively, than are necessary.

In the present study of the bactericidal effect of paraffining of paperboard, a strain of *Esch. coli* was used as the test organism. From the thermal resistance curve of this test organism, the percentage reduction was determined at 140° F. for 20 minutes, the temperature and time combination taken as lethal for the most heat-resistant pathogens transmissible through milk supplies (*12*). The thermal resistance of this strain of *Esch. coli* was such that a 24-hour skim milk culture in sterile skim milk showed a 99 percent reduction (initial count 1,000,000 colonies per cc.) at 140° F. for 20 minutes. Efforts in this study were therefore directed to determining the tem-

perature and time combinations of paraffining which would give a 99 percent reduction of this test organism on the 2-inch squares of paperboard that were tested. This criterion is based on the assumption that the same relation that exists in milk at 140° F. between the thermal resistance of the test organism and the most heat-resistant pathogen transmissible through milk supplies also holds true at higher temperatures in paraffin. However, a similar assumption is made whenever *any* test organism is used, even though the criterion is the complete killing of the test organism rather than a definite percentage reduction.

EFFECT OF MOISTURE

As paraffin is an anhydrous substance, any factors which affect the moisture content of the paperboard and especially the surface moisture at the time of paraffining would influence the bacterial reductions due to the paraffin treatment. In a test procedure, these factors would be the original moisture content of the paperboard and of the bacterial culture used, together with the drying that occurred between application of the bacterial culture and subsequent paraffining of the paperboard.

Paperboard stored under varying conditions of temperature and relative humidity will naturally vary in moisture content. The paperboard used in this work was therefore stored in a cabinet having a relative humidity of 40 to 50 percent at a temperature of about 70° F. These conditions were assumed to represent a fair average of the conditions under which paperboard would be stored in practice.

Moreover, when paperboard for test purposes is inoculated and then dried before being paraffined, the amount of drying which occurs in a given time is affected by the humidity conditions under which the drying takes place. Throughout this study the 2-inch test squares of sterilized paperboard, after immersion in the culture of the *Esch. coli* test organism, were dried in a cabinet containing a dehydrating agent so as to facilitate drying under approximately uniform conditions. The period of drying, usually about 45 minutes was regulated so as to bring the weights of the inoculated paperboard back to about their original weights in storage, making allowance for increases in weight due to the milk solids in the culture. An increase of about 1 percent in the weight of the paperboard was calculated as due to the milk solids in the culture. Weights of the individual pieces of paperboard were accurately determined at various steps in the test procedure. Regulation of the drying time was based on the total moisture content of the paperboard, as it was not considered practicable to differentiate between moisture within the paperboard and that on the surface. The initial bacterial plate count of the *Esch. coli* test organism, which averaged about 1,000,000 per 2-inch test square of

paperboard, was reduced about 85 percent during the drying period. The plate count of the paperboard after drying was used in computing the percentages reduction of the test organism due to paraffining.

Because of the inability of most of the test organisms used in experimental studies to survive for a long time on paperboard, the possible desirability of holding paperboard in storage before it is paraffined has been suggested (*6*). Increasing the time interval between occurrence of contamination of paperboard and time of paraffining would tend to reduce the contamination, but it is not

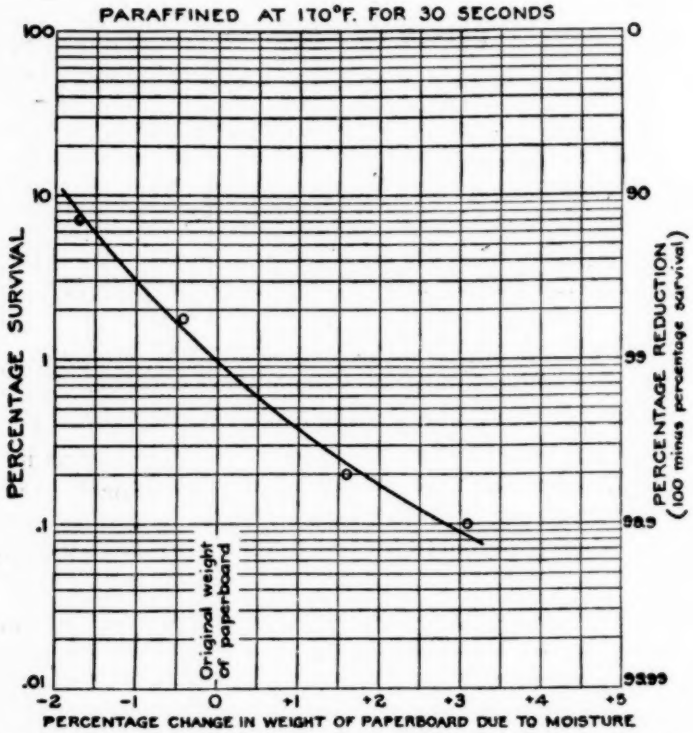

FIGURE 1.—Percentage reduction of *Esch. coli* test organism due to paraffining, as affected by moisture remaining after paperboard was dried for various periods following inoculation.

impossible for contamination to occur between withdrawal of the paper from storage and its subsequent paraffining.

A series of tests was made to determine the approximate time in the drying cabinet that would give the requisite drying of the pieces of inoculated paperboard. Drying times of 15, 30, 45, and 60 minutes were used, and all of the pieces of paperboard were paraffined at 170° F. for 30 seconds. Data regarding these tests are given in table 1, and figure 1 shows how the percentage reduction of the *Esch. coli* test organism due to paraffining was affected by the moisture that remained after the paperboard was dried for various periods following its inoculation.

TABLE 1.—*Data on inoculation and drying of paperboard and its effect on percentage reduction of Esch. coli test organism due to paraffining at 170° F. for 30 seconds*

Minutes detenton in drying cabinet	Pieces of paperboard tested	Before paraffining				After paraffining	
		Mean count of test organism on 2-inch test squares of paperboard after:		Percentage reduction of test organism due to drying	Percentage change in original weight of paperboard due to moisture remaining after inoculation and drying	Mean count of test organism on 2-inch test squares of paperboard	Percentage reduction due to paraffining
		Draining for 5 minutes	Detention in drying cabinet				
15	4	700,000	360,000	49	+3.1	350	99.9
30	8	700,000	280,000	59	+1.6	550	99.8
45	8	700,000	110,000	84	−.45	2,000	98.2
60	5	700,000	35,000	95	−1.70	2,500	92.9

EXPERIMENTAL PROCEDURE

The paraffining equipment used in this study is illustrated in figure 2. A beaker containing the paraffin was suspended in an electrically controlled constant-temperature water bath. The paraffin was continuously agitated and was kept covered at all times except for the brief periods when the pieces of paperboard were immersed in it. Paraffins having melting points of 128–130° F. and 133–135° F. A.M.P. were used. These are the two grades of paraffin said to be most frequently used by milk-container manufacturers. The grade with the lower melting point is generally used in winter as its cost is less than that with the higher melting point. Espach (*13*) stated that the main commercial property of paraffin wax was its melting point; the higher the melting point the more valuable the wax. He gave the range in the melting point of the bulk of the commercial paraffin waxes as from 118° to 136° F., but also mentioned that waxes with melting points as low as 108° F. and as high as 160° F. found commercial uses.

The paperboard used for this work was of a type used commercially in the manufacture of paper milk containers. The surface of this paperboard was quite impervious, so probably the only penetration of the contaminating culture was that which may have occurred along the cut edges of the paperboard. If the porosity of paperboard used is such that contamination can get within the paper, this contamination no doubt would be protected to some extent against the bactericidal effect of the paraffining process.

A detailed description of the laboratory test procedure using the 2-inch test squares of paperboard is as follows:

(*a*) A number of 2-inch test squares of paperboard, from the storage cabinet previously mentioned, were sterilized in the autoclave.

(*b*) After sterilization, the paperboards were returned to the storage cabinet for about 24 hours to give them an opportunity to return to approximately their original weights prior to sterilization.

(*c*) The sterile paperboards were inoculated by immersion in a skim milk suspension of the *Esch. coli* test organism (24-hour skim milk culture diluted with sterile skim milk to a plate count of about 15,000,000 per cc.), and were then drained for 5 minutes to permit run-off of excess culture.

(*d*) After draining, one of the paperboards was disintegrated in 500 cc. of sterile water and samples were plated [2] to determine the total number of organisms on the board prior to drying.

(*e*) The other paperboards after draining were placed in a drying cabinet for the length of time (usually about 45 minutes) necessary to bring their weights back to approximately the original weights in storage prior to sterilizing, making allowance for increase in weights due to the milk solids in the culture suspension.

(*f*) One or two of these paperboards were each disintegrated in 500 cc. of sterile water and samples were plated to determine the total number of organisms on the boards after drying. (This bacterial plate count was used as the initial count in determining the percentages reduction of the test organism due to paraffining.)

(*g*) The remaining paperboards, after immersion in the suspension of the test organism, followed by draining and drying as previously described, were immersed in paraffin of different temperatures for various periods of time.

(*h*) After paraffining, the paperboards were allowed to cool for 5 minutes.

(*i*) The paperboards were then each disintegrated in 500 cc. of sterile water and samples were plated to determine the percentages reduction of the test organism effected by paraffining. (Ten 1 cc. samples were plated of each disintegrated piece of paraffined board.)

RESULTS AND DISCUSSION

Figure 3 shows the mean percentages reduction of the *Esch. coli* test organism for various immersion times at paraffin temperatures of 160°, 165°, 170°, 175°, and 180° F. Each of the points on the curves represents the mean reduction of 15 to 25 separate test pieces of paperboard. For each of the paraffin temperatures studied, the rate of reduction was quite rapid at the start, and then slowed down as the immersion time increased. This slowing down in the killing rate as the length of immersion time increased may have been due in

[2] Standard nutrient agar was used for all plating work and plates were incubated at 37° C. for 48 hours. The use of standard agar rather than a differential media was possible because pure cultures of *Esch. coli* were used throughout the study. Random checks were routinely made on differential media of organisms remaining after paraffining.

Disintegration was carried out in a high speed mixer which accomplished complete disintegration of even the pieces of paraffined paperboard within 2 to 3 minutes.

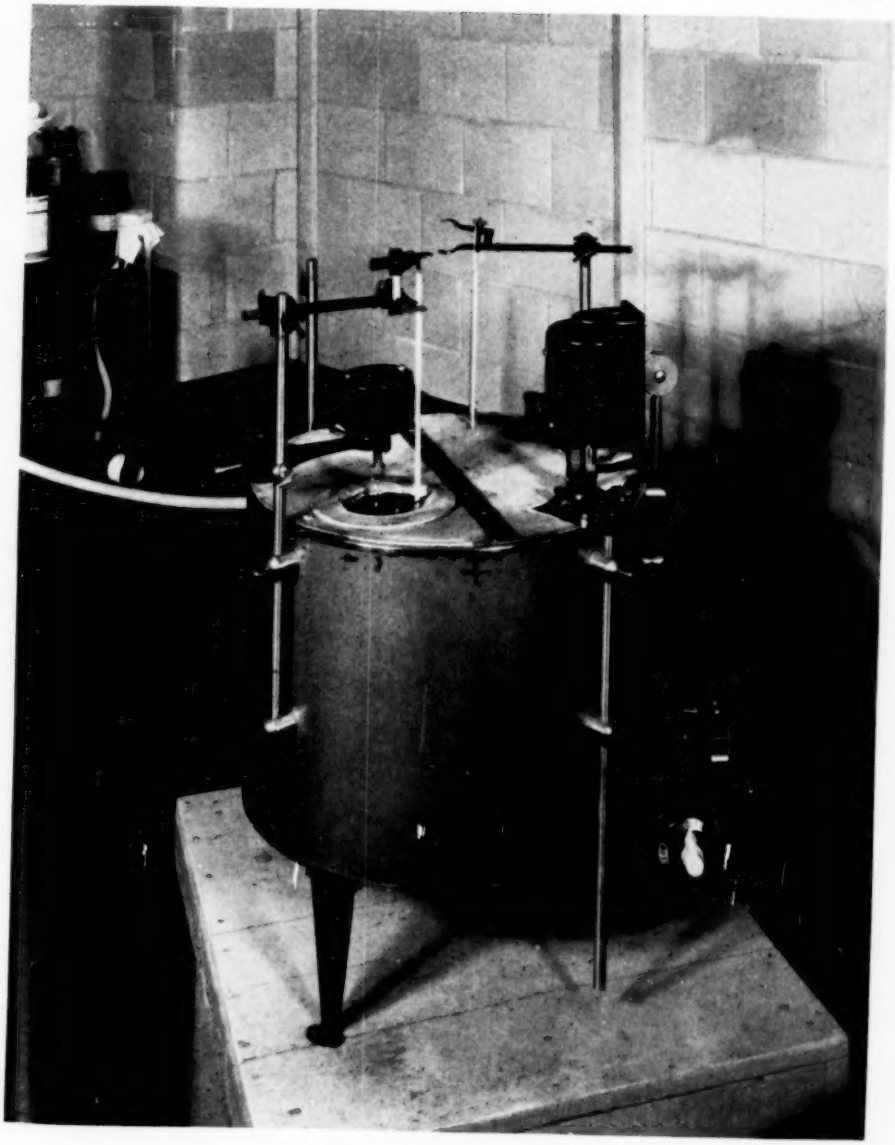

FIGURE 2.—Paraffining equipment.

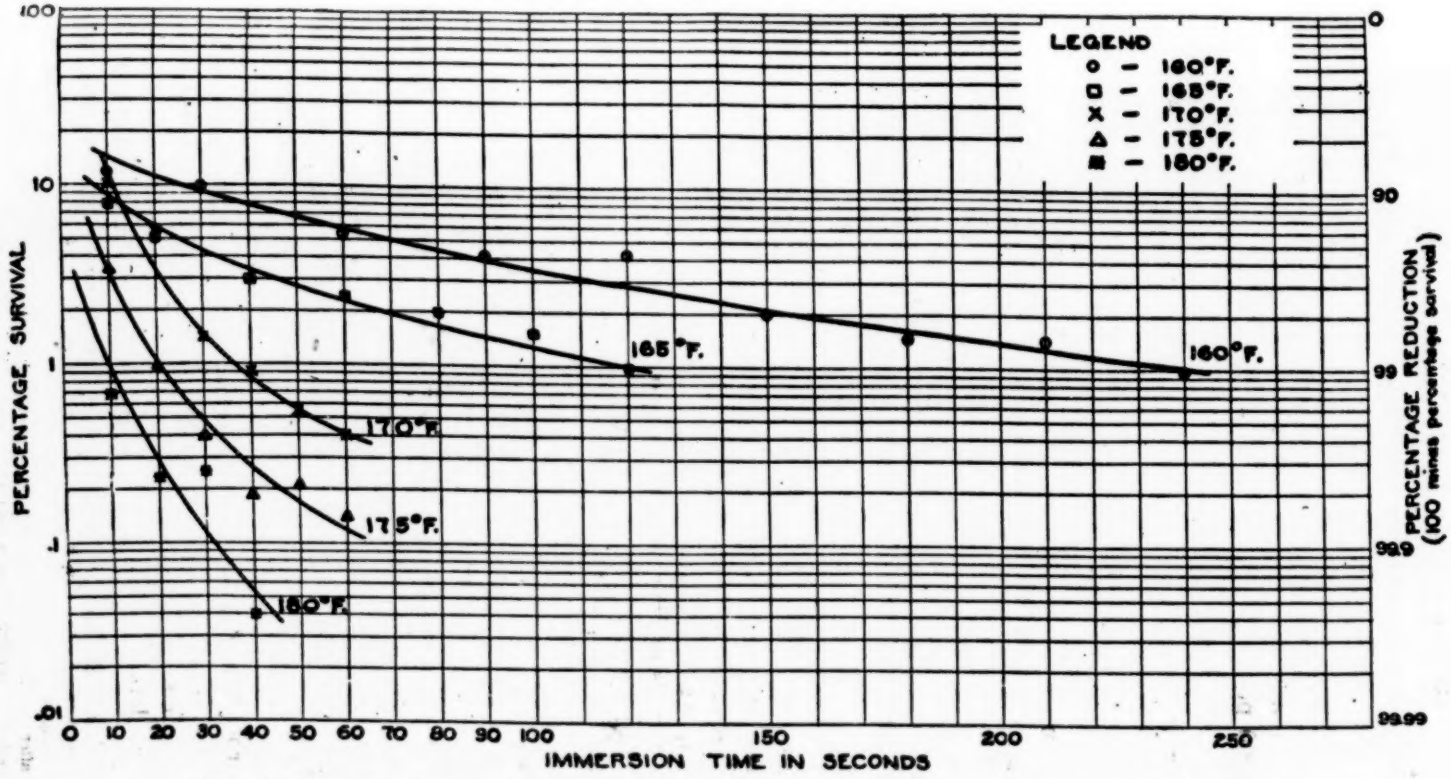

FIGURE 3.—Mean percentages reduction of *Esch. coli* test organism for various temperature and time combinations of paraffining.

part to decreasing moisture on the surface of the paperboard. It will be noted that a mean 99 percent reduction of the *Esch. coli* test organism due to paraffining (criterion reduction used) was obtained in about 10 seconds at 180° F., 20 seconds at 175° F., 35 seconds at 170° F., 2 minutes at 165° F., and 4 minutes at 160° F. The relation between immersion time and paraffin temperature for 99 percent reduction of the test organism is given in figure 4.

It has been observed by some investigators that a paraffin temperature of 180°–185° F. does not appear to be much more bactericidal, if any, than a temperature of 160° F., and that increasing the exposure

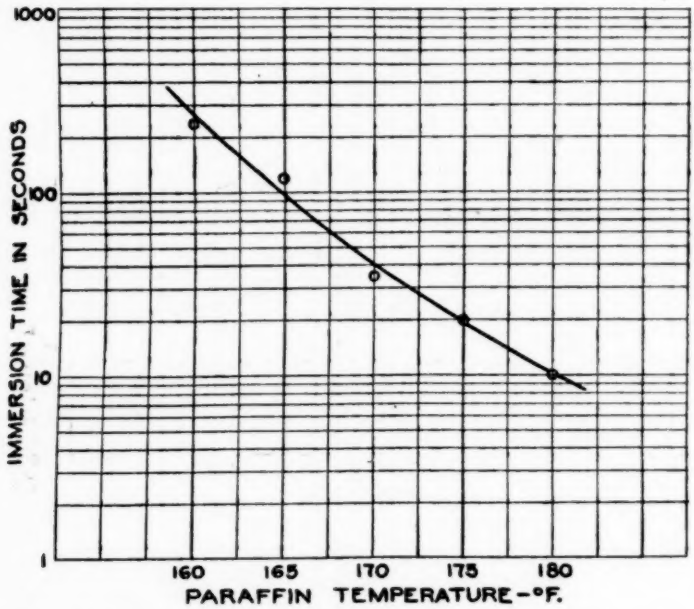

FIGURE 4.—Relation between paraffin temperature and immersion time for 99 percent reduction of *Esch. coli* test organism.

time at a given paraffin temperature does not appreciably improve the results obtained. In figure 5 there is shown the distribution of the percentages reduction of the *Esch. coli* test organism for the individual test pieces of paperboard immersed for various times in paraffin of 170° F., as well as the mean reductions for these temperature and time combinations of paraffining. This chart indicates that there was considerable variation in the bacterial reductions within each of the immersion times studied. A similar condition was found at the other paraffin temperatures studied. It was also found that at the same immersion time there was a considerable range in the paraffin temperature that produced the same percentage reduction for individual pieces of paperboard. It can therefore be stated that the range of the percentages reduction of the test organism on the indi-

vidual pieces of paperboard for the various immersion times at the same temperature, or for different temperatures at the same immersion time, overlapped each other. In a few cases, individual bacterial reductions differing considerably from the majority obtained at the same temperature and time combination were sufficient in number or magnitude to affect appreciably the mean results obtained. However, as is evident in figure 3, the mean results for the various temperature and time combinations of paraffining showed a definite trend of increased percentage reduction of the *Esch. coli* test organism

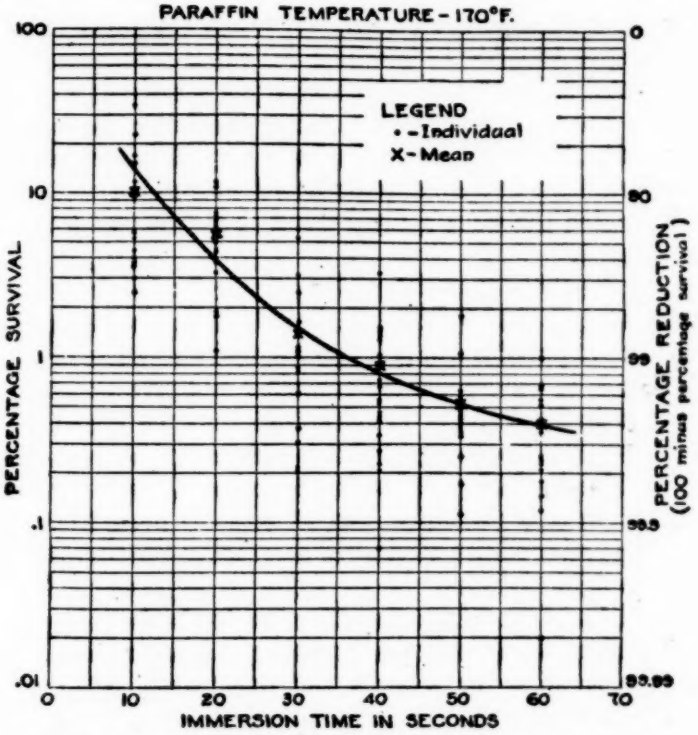

FIGURE 5.—Individual and mean percentages reduction of *Esch. coli* test organism.

with increased temperature at a given immersion time and with increased immersion time at a given temperature. When experiments on the bactericidal effect of paraffining have been directed toward determining temperature and time combinations required to produce total killing of a test organism, the variations in results for individual tests have probably covered a still wider range than was the case in this study. This additional variation would be due to the skip results occasioned by the chance survival of a few organisms for abnormally long periods and to the chances involved in sampling when very few organisms are present. If, instead of working with pure cultures, the paperboard tested has a mixed bacterial flora, wide

variations in bacterial reduction due to paraffining again may be obtained. With a mixed bacterial flora it is quite possible that, although the majority of the organisms are readily killed, a few resistant ones remain and a temperature higher than either 160° or 185° F. at the immersion times used is necessary to kill these few organisms.

Prucha (*7*) made the following statement in connection with some of his studies: "In these tests in which inoculated containers were paraffined, and a large number of these were paraffined in each test, invariably one or two containers would be positive, and that was irrespective of the temperature used. Whether the bacteria survived the paraffining or whether in handling such rich suspension an occasional accidental contamination took place, it is difficult to conclude. The heavier the inoculation, the more positive cases appeared." Prucha's results, however, as shown for a typical laboratory run, in which he paraffined strips of paperboard inoculated with *B. prodigiosus*, indicated the same general trend as the results of this study shown in figure 3.

Tanner (*6*) suggested that although a greater destruction of bacteria may be obtained at 185° F. than at 160° F., it is more than offset by the lighter coat of paraffin which is applied, and that since the function of the paraffin is to waterproof the container and give a surface which is impervious to bacteria, a heavier coat may be desirable. The viscosity of paraffin drops only slightly as its temperature is increased (*14*), so if a thinner coating of paraffin is obtained at the higher paraffin temperatures it is probably due, at least in part, to the length of the draining and cooling periods. A decrease in the time of draining and cooling might therefore be of value in improving the waterproofing qualities of containers paraffined at the higher temperatures.

Sanborn (*15*) made the following comments in discussing the effectiveness of paraffining as regards the moisture-proofing of paper containers: "Generally speaking, more satisfactory coatings of wax were obtained at 165° to 170° F. than at temperatures of 180° to 185° F. Other factors, such as the physical properties of the sheet (porosity, smoothness of surface, formation, etc.), method of paraffining and draining, temperature of container before and after paraffining, and characteristics of paraffin used, also affect moisture-proofing efficiency. With the use of higher paraffining temperatures and slow cooling, while better penetration is usually secured than at lower temperatures, there is a tendency for excessive run-off of paraffin from side seams and from parts of containers having extra thickness of paperboard, leaving exposed uncoated areas which are capable of absorbing milk and other liquids."

Stoltz and Armstrong (*16*) in a comparison of the imperviousness of commonly used paper milk containers made the following statement:

"These tests suggest that while a dipping at the higher temperatures may result in a more complete impregnation of the fiber, the drain off before cooling is excessive and leaves the fiber unprotected. A second dipping at low temperature (160° F.) will apparently result in a fairly complete protection to these containers provided the container is of such construction that the coating is not subject to excessive strain in handling."

The results of the present study indicate the greater mean bactericidal efficiency of the higher paraffin temperatures used. If the paraffining process is to serve as the bactericidal treatment for the surfaces of the paper container, the use of the higher temperatures studied appears essential, unless the immersion times generally used are considerably increased. If the use of the higher paraffin temperatures results in a paraffin coating that is too thin or otherwise unsatisfactory for practical use, it may be necessary to subject the containers to separate bactericidal and waterproofing treatments. The bactericidal treatment might be accomplished either by a paraffin bath at the higher temperatures or by some other method, followed by a paraffin bath of lower temperature to furnish the waterproofing. It is suggested that by passing the paperboard through hot air of high humidity it might be possible to render the surfaces of the paperboard sufficiently moist to facilitate bacterial reduction by paraffining without interfering with the other functions of paraffining.

SUMMARY

The paraffining of paper milk containers is discussed and results are given of other studies which have been made on the bactericidal effect of paraffining. In some studies, *Esch. coli* has been used as a test organism and the work has been directed toward obtaining the temperature and time combinations of paraffining required to produce sterility. *Esch. coli* was also used as a test organism in the present study. The thermal resistance of the strain of *Esch. coli* used in this study was such that a skim milk culture in sterile skim milk showed a 99 percent reduction at 140° F. for 20 minutes, the temperature and time combination taken as lethal for the most heat-resistant pathogens transmissible through milk supplies. The work was therefore directed toward determining the temperature and time combinations of paraffining required to produce a 99 percent reduction of the strain of *Esch. coli* that was used. Since paraffin is an anhydrous material, the moisture content of the paperboard at the time of paraffining is a factor in the bacterial reductions obtained. Moisture conditions with respect to the paperboard were therefore controlled throughout the experiment. Under the test procedure followed in this study, a mean 99 percent reduction of the *Esch. coli* test organism due to paraffining was obtained in about 10 seconds at 180° F., 20 seconds at 175° F.,

35 seconds at 170° F., 2 minutes at 165° F., and 4 minutes at 160° F. These results indicate the greater mean bactericidal efficiency of the higher paraffin temperatures used. If the paraffining process is to serve as the bactericidal treatment for the surfaces of the paper container, the use of the higher temperatures studied appears essential, unless the immersion times generally used are considerably increased. If the use of the higher paraffin temperatures is impracticable, it may be necessary to subject the containers to separate bactericidal and waterproofing treatments or provide means for increasing the bactericidal effect of paraffining.

ACKNOWLEDGMENTS

The authors wish to express their appreciation to Senior Sanitary Engineers L. C. Frank and A. W. Fuchs and Associate Public Health Engineer W. N. Dashiell for their suggestions in connection with this study and with the preparation of the manuscript.

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THE DICK REACTION AND SCARLET FEVER MORBIDITY FOLLOWING INJECTIONS OF A PURIFIED AND TANNIC ACID PRECIPITATED ERYTHROGENIC TOXIN

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In an earlier report (*1*) one of us presented a method of producing a highly potent scarlet fever erythrogenic toxin followed by purification and precipitation of the toxin. At the time it was evident that the alcohol method used for the purification was not entirely satisfactory. Further experimentation developed a more suitable culture medium and a more satisfactory method of purifying the toxin (*2*). Preliminary trial indicated that children tolerated larger doses of the precipitated toxin than of the soluble toxin. Based on the experience with alum-precipitated diphtheria toxoid it was reasoned that the stimulating effect of the insoluble streptococcus toxin would also be considerably higher. Trials in a sample group of children indicated that this was the case. Therefore it has seemed worth while to observe the effect on the Dick reaction in a much larger group and to prolong the observation over a period of years in order to measure the effect on the incidence of scarlet fever. The following presentation is a report of such a study which covers a period of 4 years and approximately 65 percent of the grammar school children in both rural and urban schools in two large counties.

PLAN OF STUDY

Type of antigen used.—During the first year of the study an alcohol purified and tannic acid precipitated toxin (*1*) was used and thereafter an ammonium sulfate purified and tannic acid precipitated toxin (*2*). The antigenic value of the two preparations in the dilutions used was the same irrespective of the potency of the parent toxins. By using suitable ingredients in the culture medium and maintaining at all times optimum conditions for growth (*2*) it is possible to obtain a highly potent toxin in a medium which lends itself to a high degree of purification by one precipitation with ammonium sulfate. For example, lot No. HL–50 contains 4.337 mg. of total nitrogen and approximately 500,000 S. T. D. of toxin per cc. in the crude state. One precipitation with ammonium sulfate (65 percent saturation) reduced the total nitrogen content to 0.728 mg. without appreciably affecting the toxin content. Resolution of the toxin and precipitation with tannic acid further reduced the total nitrogen to 0.574 mg. With this particular lot of purified and tannic acid precipitated toxin the three immunizing doses contain 0.00086, 0.00344, and 0.0115 mg., respectively. This is considerably less total nitrogen per dose than

would have been possible if unpurified toxin from a meat broth culture medium had been used.

Method of selecting the children.—During the first year consent slips were sent home with each child in the first six grades in one county, and with all children in the first eight grades in the second county. That the response was good is indicated in table 1. Naturally, the response varied with the schools, but of the actual slips sent home approximately 65 percent were returned signed, leaving 35 percent of the children as a control group. The children were then given the Dick test and those found positive were given the immunizing doses. In the succeeding years all children entering the first grade who returned signed consent slips received the immunizing injections without preliminary Dick test. It is interesting to note from table 9 that only 1,970 person-years or 4.56 percent out of the 43,158 observed were lost because of failure to complete the prescribed number of doses, a percentage which is not significantly different from the normal school absenteeism.

Method of injecting the antigen.—Following a few preliminary trials with intramuscular, subcutaneous, and intracutaneous injections, the latter was selected as the most suitable method. The selection of the intracutaneous route of injection was based partly on the ease and speed of administration and on the absence of local soreness when moving the arm. The more favorable attitude of the child to a short needle and a "skin test" as contrasted to a much longer needle and the more elaborate preparation for a deeper injection also was an influencing factor. Finally, consideration was given to the belief that such injections would allow for greater antigenic stimulation owing to slower absorption. Because of the high potency of the parent toxins obtained by the method of production used, each immunizing dose could be contained in a volume of 0.1 cc. During the period of this study 19,400 such intradermal injections of 0.1 cc. were made without the development of a single local abscess or any sloughing at the site of injection.

The number of immunizing injections and their antigenic titer.—The hope in this respect was to limit the number of injections required to a number which would be practicable administratively as well as acceptable to the child and parent. It was felt that to meet these requirements three injections per child would be the upper limit. At the same time the amount of antigen contained in each injection must not cause significant reactions and yet the total amount injected must be sufficient to cause a fairly high percentage of Dick positive individuals to become negative and to cause this status to be retained for a considerable period of time. Finally, those treated must show a degree of immunity to injection following exposure at least equal to that possessed by those who have acquired a negative

Dick reaction by other means. These requirements have led to the adoption of three injections (750, 3,000, and 10,000 S. T. D. with a 2-week interval) for children of grammar school age or younger. Routine immunization of older persons against scarlet fever is not considered advisable or necessary except in certain occupations as, for example, student nurses. Since adults are more apt to respond unfavorably to protein-containing antigens, the immunizing injections for adults have been set at four in number and containing 500, 2,000, 6,000, and 10,000 S. T. D., respectively, with a 2-week interval.

Reaction to the immunizing injections.—Since the immunizing antigen used is still a raw toxin, though in the insoluble form, specific toxic reactions will follow the injection of too large a dose. The actual amount tolerated is definitely an individual matter and cannot be predetermined from the child's history or the size of the Dick reaction. With slightly excessive doses, vomiting is the most disagreeable symptom encountered. The following tabulation shows the frequency of this occurrence with doses of varying sizes.

	S. T. D.	Number of children	Percent vomiting
First dose	2,000	309	7.8
	1,500	120	6.7
	1,000	195	.5
	750	1,000+	(1)
Second dose	7,000	18	5.5
	5,000	139	20.1
	5,000	164	14.0
	3,000	1,000+	(1)
Third dose	12,000	319	6.6
	10,000	1,000+	(1)

[1] Rarely.

Out of 3,797 first grade children receiving the immunizing doses without a preliminary Dick test during the last 3 years of the study 3,403, or 89.6 percent, were present for all three injections, an attendance record which probably is within the normal expectancy. Normal absenteeism accounts for the 394 who failed to receive all three injections, since no child or parent refused to complete the full course. In another group of 1,203, comprising the first six grades, 0.41 percent refused to complete the three injections whereas 8.8 percent were absent for reasons unrelated to the immunizations. A check of the attendance records in an adequate sample of the first grade rooms failed to show any abnormal absenteeism on the days immediately following the injections. From the foregoing information it would appear that the amount of toxin in the three injections adopted for this study is sufficient to produce significant constitutional symptoms only in an occasional child.

Reaction at the site of injection occurs in practically every individual but in widely varying degree. Induration is always present

and tenderness on palpation is usually present in some degree, whereas pain on motion is usually absent. Redness of varying degree is usually present and if itching is present it varies with the extent of redness. Localized heat is present in those showing the larger areas of redness and induration. A vesicle the size of a pinhead containing clear serous fluid frequently forms at the site of the needle insertion in those with the more intense local reactions.

All of the injections were made without prior questioning with regard to the presence of allergy. Four children were observed who gave reactions of an allergic character following the first or second injections. The reactions were mild and did not require specific treatment.

DICK REACTION IN THE STUDY GROUP

The two counties were selected for study for two reasons: (*a*) Because there had previously been no active immunization against scarlet fever nor had there been any Dick test studies made, and (*b*) because of the relatively high incidence of scarlet fever. Therefore, the figures which are to be presented represent the susceptibility reactions in a virgin population in a section where scarlet fever has been a disease of rather frequent occurrence.

The test toxin used.—Throughout this study freshly diluted test toxin for the Dick test was prepared by properly diluting the National Institute of Health standard toxin. This toxin contains 30,000 S. T. D. per cc. and is made with the Dochez NY-5 strain. A sample representing one of the used vials from each field trip was brought back to the laboratory and checked for potency against a fresh standard. The test injections were made into the skin of the upper inner quarter of the forearm. Readings were made only once and this 18 to 24 hours following the injections. A reaction 10 x 10 mm. in area or its equivalent, or larger, was considered positive irrespective of the intensity or amount of accompanying edema. (The accumulated data suggest that a more rigid interpretation might be better.)

Percent of the population tested.—The method of securing the children for study has already been mentioned. Column 1 of table 1 gives the number of persons available for the Dick test in each age period and column 3 gives the number and column 2 the actual percentage of the total who were given the Dick test. It will be seen that for the grammer school ages the sample represents an adequate portion of the children present.

The Dick reaction in the study group.—Columns 4 and 5 of table 1 give the age distribution of the Dick positive children, a distribution which can be regarded as typical for this test in any representative community.

TABLE 1.—*The Dick reaction in children of certain age groups in Allegany and Garrett Counties, Md.*

Age	Combined population of the 2 counties	Percent of population given the Dick test	Number given the Dick test	Results of Dick test	
				Number positive	Percent positive
Under 5	7,818	0.7	52	32	61.5
5	1,726	4.3	74	46	62.2
6	2,208	56.7	1,252	702	56.1
7	2,152	63.7	1,370	689	50.3
8	2,207	66.9	1,477	654	44.3
9	2,321	70.0	1,625	663	40.8
10	2,299	71.4	1,642	601	36.6
11	2,349	64.0	1,503	555	36.9
12	2,421	41.5	1,004	329	32.8
13	2,269	25.3	574	192	33.4
14	2,338	12.3	288	83	28.8
15	2,335	7.9	184	59	32.4
16	2,282	3.5	81	26	32.1
17	2,018	2.6	52	23	44.2
18	1,942	.6	12	5	41.7
19	1,679	----	2	1	----
20 and over	65,121	----	----	----	----
Total	105,485	----	11,192	4,660	----

TABLE 2.—*Relationship between the Dick positive status of school children and the reported scarlet fever morbidity rate, also the expected morbidity rate based on the experience of the 7-year-old group*

Age	Percentage of population Dick positive [1]	Average annual morbidity rate per 1,000 [2]	Expected morbidity based on experience of 7-year-old group	Age	Percentage of population Dick positive [1]	Average annual morbidity rate per 1,000 [2]	Expected morbidity based on experience of 7-year-old group
5	62.2	16.0	20.0	11	36.9	7.8	11.9
6	56.1	15.0	18.1	12	32.8	7.3	10.6
7	50.3	16.2	16.2	13	33.4	3.8	10.8
8	44.3	15.2	14.3	14	28.8	4.4	9.3
9	40.8	11.5	13.1	15	32.4	2.3	10.4
10	36.6	11.7	11.8	16	32.1	2.5	10.4

[1] Dick reaction percentages based on tests on 10,993 children who previously had received no injections of immunizing antigen.

[2] The scarlet fever morbidity is based on 6 years of experience in 1 county and 3 years in the other, giving a total of 128,925 person-years.

Attacks of scarlet fever occur almost exclusively in persons having a positive Dick reaction. The data made available by the present study permit an evaluation of the significance of a positive skin reaction in relation to age. The Dick positive distribution for the school ages is presented in column 1 of table 2, whereas the actual morbidity rates for these ages on the basis of past experience in the two counties are presented in column 2. Since the Dick reactions are based on 10,993 observations and the morbidity rates on approximately 128,925 person-years (see footnotes to table 2) and extending over a period of years the data assume significant proportions. The morbidity rate is highest at 7 years of age, indicating that at this age period the Dick positive state holds its greatest significance. Based on the Dick positive-scarlet fever morbidity ratio at the age of 7 the morbidity expect-

ancy for the other ages is as reported in column 3 of table 2. It will be seen that the expected rate is increasingly higher than the actual with advancing age until at the age of 15, for example, the actual rate is only approximately one-fifth of the expected. This fact should have weight when any active immunization program is considered. Undoubtedly, a similar relationship exists between the Schick reaction and diphtheria.

Since no active immunization work had been carried out in these two counties previous to the present study, any Dick negative children must have acquired their immunity through an attack of the disease or through one or more exposures to the streptococcus in subclinical degree. Reporting of clinically recognized cases in the two counties has been considered very good and it is known that an attack usually renders the individual Dick negative. From the data at hand it is possible, therefore, to calculate the percentage of the children at each age who probably became negative from an attack of the disease. Beginning with 2.9 percent at 6 years of age this percentage gradually increases by years, from 7 to 15, in the following manner: 4.2, 5.3, 6.1, 7.2, 7.9, 8.3, 9.5, 9.6, and 9.8. Similarly, the percentage of all the children at each year of age who probably became Dick negative through subclinical exposure is 41.0 at 6 years of age and 43.5, 50.4, 53.1, 56.2, 55.2, 58.9, 57.1, 61.6, and 57.7 for the succeeding years. These percentages will vary in a given community on the basis of the chance of exposure to the hemolytic streptococcus that has existed over a period of time.

TABLE 3.—*Influence of the size of the immunizing dose and the time interval since immunization on the immunity status as measured by the Dick test*

Elapsed time, months	Less than 5,000 S. T.-D. of toxin			5,000–10,000 S. T. D. of toxin			13,750 or 16,000 S. T. D. of toxin		
	Total	Negative	Percent negative	Total	Negative	Percent negative	Total	Negative	Percent negative
1–2	172	96	55.8	439	362	82.4	1,008	842	83.5
21	28	15	53.6				325	287	88.3
23				89	65	73.0			
36–37	5	2					21	19	90.5
44–47	23	16	69.6	70	56	80.0	202	172	85.1

Durability of the negative Dick reaction.—Groups of treated children have been retested from time to time. The results of such retests are shown in table 3 where all those retested have been arranged without regard to age but on the basis of the elapsed time and the size of the immunizing dose. All children in these groups were Dick positive before beginning the immunizing doses. The retest figures bring out two rather unexpected facts: First, that a very considerable percentage of Dick positive children can be made Dick

negative with very small doses of purified and tannic acid precipitated toxin, and, second, that irrespective of the size of the immunizing dose the negative reaction, if once acquired, is retained for a considerable period of time.

The data in table 3 are based on the group as a whole and do not record what may happen to the individual child. Certain children were carried through two retests and a smaller group through three retests. These data are shown in table 4. The numbers involved in the second and third retests are not large except for those children receiving 13,750 or 16,000 S. T. D. of toxin. The latter group shows an actual increase in the number of Dick negative with each succeeding retest. The smaller immunizing doses appear to have been enough to maintain the negative level at least through a period of 44 to 47 months.

TABLE 4.—*Durability of immunity as measured by retests on the same persons following injections of purified and tannic acid precipitated toxin. (All persons were Dick positive when treatment began)*

a. First retest approximately 1 month after last immunizing dose

Size of immunizing dose, S. T. D.	Number retested	Number negative	Percent negative
4,000–5,000	172	96	55.8
6,000–9,000	439	362	82.4
13,750–16,000	1,008	842	83.5

b. Second retest 21 to 23 months after last immunizing dose

Size of immunizing dose, S. T. D.	First retest same children, percent negative	Result of second retest		
		Number	Negative	Percent negative
3,750	56.5	23	11	47.8
6,000 or 8,000	88.4	86	64	74.5
13,750 or 16,000	84.1	308	272	88.1

c. Third retest 44 to 47 months after last immunizing dose

Size of immunizing dose, S. T. D.	Previous retests on same children		Results of third retest		
	Percent negative first retest	Percent negative second retest	Number	Negative	Percent negative
3,750 or 4,000	37.5	25.0	8	3	37.5
7,000 or 8,000	86.4	81.8	22	18	81.8
13,750 or 16,000	78.8	85.9	85	74	87.1

The retest data have been analyzed in table 5 in an effort to show the constancy of the Dick reaction in succeeding retests irrespective of what it was on the first. It also has been possible to include in this table retest results on 341 children who were Dick negative in

the original test and therefore received no treatment. After a lapse of 45 months 331, or 97.1 percent, were still negative. For those who were Dick positive and received immunizing doses the probabilities of changes in the second retest over the first are somewhat greater, as is shown in table 5b. The variations in three retests are shown in table 5c.

TABLE 5.—*Variations in the Dick reaction as determined by second and third retests in the same individuals*

a. Retests on persons who were negative on the original tests

Elapsed time first to second tests	45 months.
Negative on first and second tests	331 or 97.1 percent.
Negative on first and positive on second	10 or 2.9 percent.

b. Positive on original test and given immunizing doses as indicated

Size of immunizing dose, S. T. D	5,000		7,000 or 8,000				13,750 or 16,000			
Elapsed time first to second retests	21 months		23 months		46 months		21 months		44 months	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Negative on first and second retests	18	41.8	58	67.4	48	71.6	235	76.3	119	66.1
Negative on first and positive on second	5	11.6	18	20.9	5	7.6	24	7.8	18	10.0
Positive on first and second retests	15	35.0	4	4.7	7	10.4	12	3.9	11	6.2
Positive on first and negative on second	5	11.6	6	7.0	7	10.4	37	12.0	32	17.7

c. Variations in the second and third retests over first retest

Size of immunizing dose, S. T. D	5,000	7,000 or 8,000	13,750 or 16,000	
			Number	Percent
All 3 tests in agreement	6	17	56	65.9
Second retest a reversal of first but in agreement with third	1	5	16	18.8
Second retest a reversal of first but in disagreement with third	1	0	13	15.3

Table 5 also permits a measurement of the permanence of the Dick negative state following active immunization as contrasted to that which has been acquired "naturally." It has just been stated that 97.1 percent of those "naturally negative" retained their status over a period of 45 months. Of 76 persons (table 5b) who received 7,000 or 8,000 S. T. D. and were negative on the first retest, 58, or 76.3 percent, retained the same reaction after 23 months whereas 48, or 90.6 percent out of a group of 53, were still negative after 46 months. When the immunizing dose was 13,750 or 16,000 S. T. D., 235, or 90.7 percent out of 259, still retained their negative skin reaction after 21 months, and after a lapse of 44 months, 119, or 86.9 percent of 137 children, were still negative. Thus those who acquired their im-

munity through hypodermic injections of toxin fell below those "naturally immune" in their ability to retain their immunity. However, the difference is not great and may not be significant. A very large majority of those naturally immune received their immunity through subclinical exposure. It is not unlikely that this group comprises those persons in the community who require the least amount of antigen for satisfactory antibody production.

TABLE 6.—*Influence of age on the probability of the Dick reaction becoming negative following the immunizing injections*

Age	Immunizing dose: 5,000 to 10,000 S. T. D.				Immunizing dose: 13,750 or 16,000 S. T. D.			
	Total	Negative	Percent negative		Total	Negative	Percent negative	
6	94	63	67.0	70.1	183	142	77.6	78.7
7	93	62	66.7		151	116	76.8	
8	79	65	82.3		152	119	79.4	
9	99	66	66.7		161	132	81.9	
10	72	60	83.4	84.8	128	111	86.7	88.3
11	64	56	87.6		131	113	86.4	
12	26	20	77.0		67	61	91.1	
13	9	9	100.0		34	33	97.0	

On retest 150 Dick positive student nurses showed 118 or 78.6 percent as negative.

A limited number of student nurses have been immunized with the purified and tannic acid precipitated antigen. Approximately 25 percent of these girls were Dick positive when they came to the hospital for the first time. Without reference to the elapsed time before the retest, 14 out of 16 Dick positive girls became negative after receiving less than 10,000 S. T. D. of antigen and 118, or 78.7 percent out of 150, became negative after receiving 10,000 to 25,000 S. T. D. Analysis of this latter group of 150 girls on the basis of the elapsed time before the retest shows that of 76 who were retested less than 6 months after the last immunizing dose 61, or 80.3 percent, had become negative. Of 74 others retested after an interval of 6 to 22 months 57, or 77.0 percent, were negative.

The number of children receiving the first retest after immunization was sufficiently large to indicate the influence of age on the probability of acquiring a negative reaction. The data presented in table 6 show that within the ages observed children became easier to render Dick negative as they grew older. However, with the 150 student nurses the percentage of Dick negatives obtained fell to the level of the 6-year-olds. It is probable that two factors exert an influence. The younger children have not had much immunity experience and thus as a group require greater antigenic stimulation, and, second, the ease with which the individual person produces antibodies varies greatly. Thus, in the younger ages, immunity is more difficult because of lack of immunity experience but this factor becomes

less dominant as the child experiences the close and multiple contacts of school life. On the other hand, with an adult population the residual of Dick positive persons probably represents for the most part those individuals who are poor antibody producers and are therefore difficult to immunize.

SCARLET FEVER MORBIDITY

The scarlet fever morbidity study period began December 1, 1936, and was closed on October 31, 1940. In each of the intervening years a group of newly immunized children was added to the study as soon after the opening of school as the injections could be completed (some time in October). Thus one group of children was observed for more than 3 years but less than 4, and other groups for 3 years, 2 years, and 1 year, respectively. For the purposes of statistical analysis the observations have been reduced to person-years. It will be seen from table 9 that a total of 41,109 person-years is included in the study group in addition to a control group.

Annual morbidity rates.—The annual morbidity rates for all ages for the two study counties, as well as the contiguous counties, are given in table 7. In general, the trends are the same in each county, namely downward, and irregular in character so that on an annual basis any influence of the immunizations given in the two study counties is not apparent.

TABLE 7.—*Annual scarlet fever morbidity rate per 1,000 for the two study counties and contiguous areas* [1]

Year	Maryland			Pennsylvania			West Virginia	
	Allegany	Garrett	Washington	Bedford	Fulton	Somerset	Mineral	Preston
1930	----	----	2.00	1.61	8.89	5.40	5.00	----
1931	5.20	----	2.24	1.65	9.71	4.66	5.81	----
1932	4.15	----	2.15	2.50	2.73	2.77	12.73	----
1933	2.87	----	2.95	5.16	2.59	1.68	5.39	3.09
1934	3.43	5.70	2.19	1.68	3.98	2.27	4.58	2.44
1935	2.45	5.45	1.43	1.43	2.71	2.24	2.95	5.01
1936	1.67	2.99	1.85	.30	2.38	.90	1.39	2.44
1937	1.30	3.85	1.37	1.08	4.89	2.49	1.48	1.74
1938	.91	3.58	.95	1.99	1.35	.77	2.38	2.02
1939	1.59	1.84	2.00	2.69	.48	.61	1.65	3.66

[1] Morbidity study period: Dec. 1, 1936, to Oct. 31, 1940.

Seasonal distribution.—As is to be expected, immunization in the two counties made no change in the monthly distribution of cases over the pre-immunization period.

Sex.—Endemic scarlet fever in preschool and school children shows no sex preference. Among adults endemic scarlet fever does show a social distinction in that parents of young children are more apt to become infected than other adults, and mothers more so than fathers.

In the two study counties, 57 and 68 percent, respectively, of the reported cases of scarlet fever in persons 18 years of age or over were in married women.

Age.—If the quantities of precipitated toxin used in this study afforded any protection against subsequent attacks of scarlet fever a change in the age distribution of reported cases would follow, since treatment was given only in the grammar school ages. Column 2 in table 8 gives the percentage of the total cases occurring at each year of age for the period before immunization. The peak of cases falls at 7 years of age (see also the morbidity rates in table 2). Column 4 gives similar figures for the study period. It will be seen that the peak of cases now falls in the fourth and fifth years of life. Children of these two ages surely represent the most vulnerable members of the community either above or below the ages included in the study group because of their degree of susceptibility and their social habits. A summary of the data in table 8 (see last 3 lines of table) shows that 61.9 percent of all the cases before immunization and 46.7 percent during the study period occurred in the age group 6–15 (both inclusive). Similarly, 24.6 percent and 37.8 percent, respectively, occurred in the group 5 years and under. On the basis of the percentage distribution in the pre-immunization period the expectancy for the 6–15-year group during the study period was 564 cases as against the 277 reported.

TABLE 8.—*Age distribution of reported cases of scarlet fever for the period before active immunization and for the study period*

Age	Period before immunization		During the study period		Age	Period before immunization		During the study period	
	Cases	Percent	Cases	Percent		Cases	Percent	Cases	Percent
Under 1	10	0.58	12	2.02	15	28	1.61	13	2.19
1	26	1.50	3	.51	16	29	1.67	2	.34
2	59	3.40	27	4.55	17	20	1.15	8	1.35
3	117	6.74	57	9.61	18	15	.86	7	1.18
4	80	4.61	63	10.63	19	11	.63	7	1.18
5	136	7.83	62	10.46	20 and over	159	9.16	68	11.47
6	162	9.33	48	8.09					
7	178	10.25	51	8.60	Total	1,736	100.0	593	100.0
8	168	9.68	34	5.73					
9	130	7.49	39	6.58	Group 5 years and under	428	24.6	224	37.8
10	133	7.66	23	3.88	6–15 years (inclusive)	1,074	61.9	277	46.7
11	94	5.41	21	3.54	Over 15 years of age	234	13.5	92	15.5
12	89	5.13	21	3.54					
13	41	2.36	11	1.85					
14	51	2.94	16	2.70					

Reported scarlet fever during the study period.—Table 9 gives the number of person-years observed in the various categories. The numbers are fairly large, especially in the group which was Dick negative on the original test and therefore was not treated, and the one which was Dick positive and then treated. These two groups have added significance since they were under observation for a

period of 44 to 47 months. The group which was treated without a preliminary Dick test represents children observed 3, 2, or 1 years (about equally divided). The last group, which is labeled "given 4,000 S. T. D. or less" is composed of those children who were present only for the first dose or the first and second doses. Since the number of children in this group is very small and the amount of antigen received inadequate, it is dropped from further consideration.

TABLE 9.—*Person-years included in the various groups*

Age	Control group	Entire study group	Dick negative group	Given 5,500–16,000 S.T.D.		Given 4,000 S.T.D. or less [1]
				Dick positive	No Dick test	
Under 5	33,169	196	23	23	150	13
5	6,605	528	47	43	438	50
6	4,916	3,271	474	405	2,392	342
7	4,179	3,914	1,099	897	1,918	348
8	4,272	4,177	1,878	1,355	944	312
9	4,171	4,590	2,624	1,761	205	197
10	4,123	4,786	3,029	1,702	55	157
11	4,280	4,834	3,175	1,634	25	150
12	4,799	4,500	3,080	1,408	12	137
13	5,336	3,716	2,654	1,056	6	118
14	6,768	2,699	2,021	672	6	76
15	7,487	1,670	1,364	306	----------	41
16	8,129	921	860	61	----------	17
17	7,846	591	546	45	----------	7
18	7,715	361	339	22	----------	3
19	6,479	205	199	6	----------	2
20 and over	329,978	150	148	2	----------	0
Total	450,252	41,109	23,560	11,398	6,151	1,970

[1] Not included in the totals for the entire study group.

Table 10 is a record of the cases of scarlet fever reported during the study period. Using the person-year data in table 9 and the case report data in table 10, morbidity rates in a standard population have been calculated in order to afford a common basis of comparison between the several study groups. Such rates for the grammar school ages are given in table 11. The standard population used represents the total school census population for the respective ages in the two counties at the close of the study. The rates for the control group given in column b represent the ratio occurring in that portion of the population which was neither Dick tested nor treated. This group comprises about 35 percent of the children at the ages indicated, and prior to the immunizing injections in the study group it was comparable with respect to susceptibility to scarlet fever to the remaining 65 percent included in the rates in column c, except that the control group probably contained a slightly higher percentage of Dick negative children. Parents whose children had had scarlet fever as a rule did not sign the consent slips. The rates arranged in column c represent the morbidity rates for children who were Dick negative (column d) on the original test, plus those Dick positive (column e) and given 5,500 to 16,000 S. T. D. of precipitated toxin and those treated with-

out regard to the skin reaction (column f). Therefore the rates in columns b and c are calculated on two groups of children similar except for the fact that the Dick positive portion of the study group received injections of precipitated toxin.

TABLE 10.—*Cases of scarlet fever reported for the study period*

Age	Control group	Entire study group	Dick negative group	Given 5,500–16,000 S. T. D.	
				Dick positive	No Dick test
Under 5	191	1			1
5	59	2			2
6	48	6	0		6
7	43	14	2	3	9
8	31	5	1	2	2
9	41	6	3	2	1
10	22	4	2	2	
11	20	2	1	1	
12	13	6	3	3	
13	12	1	1	0	
14	14	1	0		
15	14	0	0		
16	2	0			
17	11	0			
18	8	0			
19	8	0			
20 and over	73	0			

TABLE 11.—*The annual scarlet fever morbidity rates per 1,000 in the various groups calculated against a standard population*

Age	Standard population (a)	Untreated control group (b)	Study groups			
			Entire group (c)	Dick negative (d)	Immunizing dose: 5,500 to 16,000 S. T. D.	
					Dick positive (e)	No Dick test (f)
6	2,208	9.76	1.83	0.00	0.00	2.51
7	2,152	10.29	3.58	1.82	3.34	4.71
8	2,207	7.25	1.20	.53	1.47	2.12
9	2,321	9.83	1.31	1.14	1.13	4.88
Total, 6–9	8,888	9.29	1.96	.87	1.47	3.56
10	2,299	5.33	.83	.66	1.17	
11	2,349	4.67	.41	.31	.62	
12	2,421	2.71	1.33	.97	2.13	
13	2,269	2.25	.27	.38	.00	
14	2,338	2.07	.00	.00	.00	
15	2,335	1.87	.00	.00	.00	
Total, 10–15	14,011	3.15	.48	.39	.66	

The morbidity evidence presented in table 10 confirms the Dick reaction data given in tables 3 to 6. The amount of immunizing substance injected caused approximately 80 to 90 percent of those treated to develop a negative Dick reaction, which, theoretically at least, means protection against scarlet fever. Similarly, table 11 shows that when the Dick positive children in the study group had received immunizing injections the subsequent scarlet fever attack

rate for the whole group remained definitely lower than in a control group composed of comparable persons. In the 6–9-year age group the attack rate was one-fifth that of the control rate and for the 10–15-year age group it was one-sixth. Failures occurred both in the Dick negative children (column d) and in those known to be Dick positive but treated (column e). It must be remembered that the control group (column b) comprises rates on both negative and positive reactors. If the Dick test could have been applied to the children of the control group at the beginning of the study as was done to the study group, the comparisons in table 11 would have been even more striking, as is suggested from the Dick positive rates given in table 1.

Thirteen cases of scarlet fever (table 10, column 3) occurred among those children who had a negative Dick reaction on original test. It was found (table 5) that 2.9 percent of such negative reactions revert to a Dick positive state in a 45-month interval. Using this reversion rate in the children included in column d and the expected attack rate in the resulting group, computed on the basis of other pertinent data previously presented, it is found that the expectancy is 9 cases in the Dick negative group against 13 which actually occurred.

Similarly, failures occurred with Dick positive children (table 11, column e) who were given immunizing doses. However, if corrections are made on the basis of the data presented in preceding tables it is found that the expected number of cases in this group is 23 cases as against 13 reported (table 10, column 4). Thus the actual morbidity rate for the Dick positive children who received injections is considerably less than is to be expected on the basis of the immunity obtained (table 6) as measured by the Dick reaction after immunizing.

The experience with the group of children who were given immunizing injections without a Dick test is not so satisfactory. Among children 6–9 years of age there were 5,459 person-years treated, and a total of 18 cases of scarlet fever was reported. The expectancy in this group is only 8 cases when calculated from the basic data presented in previous tables. Undoubtedly there was a good reason for this discrepancy, but a careful analysis of the available data does not reveal it. There was no grouping of the cases with respect to the elapsed time since the last immunizing dose (54 to 747 days) nor were the cases restricted as to age. Sixty-seven percent of the failures occurred in the 5-month period beginning in September 1939, whereas of the cases occurring in the control group only 22 percent developed during this interval. Consideration must be given to the possibility that a streptococcus strain may have appeared for this short interval which was antigenically different from the NY–5 strain which was used both for the skin test toxin and the immunizing toxin. Unfortunately, cultures were not isolated from the failures and in this respect the study is weak.

There are certain other considerations which must be borne in mind when evaluating the Dick reaction reported on retesting the immunized children (tables 3 to 6) and when analyzing the reported cases of scarlet fever in the various categories (table 10). In interpreting the skin reactions no regard was given to the possibility of a false reaction due to reaction to the nonerythrogenic toxin portions of the test toxin. It is known that immunizing injections influence the chances of false reactions as does also age of the individual and previous exposure to the streptococcus. Similarly there is the possibility that partial immunity may alter the severity of an attack of scarlet fever and thereby render the clinical diagnosis more uncertain. The basis for the inclusion of cases in the various groups of table 10 was always the clinical opinion of the physician making the report, whether family doctor or health officer. Since laboratory assistance in diagnosis was not available in all cases, information of this character was not considered in any of the cases presented in table 10. The general tendency throughout the two counties was to make a definite diagnosis of scarlet fever even in doubtful cases, in order the better to protect the community.

Additional evidence of the protective value of the injections given is the experience in the communities along the western border of one of the counties studied (Garrett). A rather high percentage of all the children in this area had been receiving immunizing injections since the fall of 1935, whereas in the neighboring county of Preston, W. Va., none had been given. In the winter of 1939–40 an excess of approximately 100 cases of scarlet fever was reported for the school areas of Preston County, particularly those lying next to Garrett County. The usual free movement of persons between the various communities continued without restriction. Nevertheless, no case of scarlet fever developed in the nearby Garrett County schools and daily school inspection failed to reveal cases of septic sore throat or other communicable hemolytic streptococcus diseases.

DISCUSSION

This study of active immunization against scarlet fever and its influence on the incidence of this disease has brought out some important immunological facts which are applicable not only to scarlet fever but must also be equally applicable to other diseases having a similar basis for acquiring immunity.

First in this series of observations is the fact that the amount of antigen required in different individuals to change a reaction of susceptibility to one of immunity varies over a very wide range. In some of the individuals observed this was as low as a single injection of 750 S. T. D.; in others many times this amount was needed. For example, in a limited number of observations two separate courses of

injections, each totaling 13,750 S. T. D., failed to bring about a negative skin reaction. In one adult two separate courses of 13,500 S. T. D. and 18,500 S. T. D. were given, followed by an attack of clinical scarlet fever, and still the skin reaction remained positive, accompanied by a negative control test. However, as shown by the data presented in this study, a large majority of the susceptible children respond favorably to the injection of an amount of antigen which is within the range of practicability.

The data also show the converse to be true, namely, that the ease with which a negative skin reaction shifts back to positive is also subject to individual variation. However, a rather unexpected observation in this respect is that once the individual has acquired a negative reaction it appears to last nearly as long irrespective of the amount of antigen needed to bring it about. The negative reaction which is acquired through clinical or subclinical exposure appears to have somewhat greater permanency than that following injections of antigen, though this superiority is not altogether significant. The explanation for this may be (*a*) that those who acquire a negative reaction from subclinical exposure are those who are most easily immunized, or (*b*) that their stimulation is spread over a long period as contrasted to the brief period accompanying the injections.

Some evidence is presented which indicates that the positively reacting child of 6 is more difficult to render negative than are his schoolmates of 10 or 12 years of age. The increasing amount of immunity experience with each added year of contact with his fellows probably underlies this change. However, at a somewhat older age the remaining Dick positive group probably represents the residual of the persons who did not profit so readily by repeated subclinical exposures. The latter is suggested by the response to antigen injections obtained in a small group of student nurses.

It appears from the analysis of the morbidity data that a negative Dick reaction is a dependable index of protection against clinical scarlet fever. There appears to be no choice between a negative reaction acquired through clinical or subclinical experience which, in the latter instance at least, probably is experience with a heterologous group of strains or a negative reaction acquired from the injection of an antigen derived from a single strain of hemolytic streptococcus having the antigenic qualities of the NY–5 strain. The morbidity data show failures in both instances. However, an analysis, based on the data showing the durability of the negative phase in the various groups and that showing the percentage of reactors who become nonreactors following injections of the precipitated antigen, shows that the failures are not more frequent than could occur in persons who would be expected to revert to a positive reaction.

A comparison of the Dick reactions by individual ages in the grammar school group with the average annual scarlet fever morbidity rates for the same ages over a period of years shows that a positive reaction does not bear the same significance at each age in terms of risk of contracting the disease. The risk to the individual in having a positive reaction grows progressively less with advancing age. The most obvious cause for this would seem to be the social and hygienic habits of the individual, though more obscure factors may also play a part. While this age difference is something to which the pediatrician need give little consideration in planning individual protection, it certainly is a significant factor for the health officer in planning community-wide protection and it shows the most advantageous point at which to concentrate his efforts.

Finally, consideration must be given to the practicability of the method used for the production of immunity. In this connection, many factors must be carefully weighed. But, in the final analysis, the degree of practicability can be evaluated by the response obtained from the children, parents, and teachers from year to year, by the percentage of those treated who become Dick negative and the durability of this phase, and finally by the protection afforded against the disease as indicated by the morbidity rates in the various categories. A review of the data accumulated during a 4-year study, which involved 41,109 person-years of observation in the study group and approximately the same number in a control group, shows that the interest and cooperation of the children, parents, and teachers have not fallen off, as indicated by the percentage of the children bringing signed consent slips from home and by the fact that the children, almost without exception, are voluntarily appearing for each of the three injections. The data show that approximately 85 percent of those treated became Dick negative and that few individuals subsequently lose this negative phase over a period of 44 to 47 months, while for the entire group there is actually an improvement in the percentage during this interval. The morbidity reports show that the injections afford protection against an attack of scarlet fever to the extent that they bring about a negative Dick test, and that the protection is as good as that afforded by the acquisition of a negative reaction through clinical or subclinical exposure.

The dosage, the injection method, and the time interval which seems both practicable and effective for children of grammar school age, when purified and tannic acid precipitated hemolytic streptococcus erythrogenic toxin (NY–5 strain) is used, is three graduated injections (750, 3,000, and 10,000 S. T. D.) spaced at 2-week intervals and injected in 0.1 cc. doses intradermally, preferably on the outer surface of the upper arm. When dealing with the individual a retest may be made one or more months after the last injection and if found

positive the third dose may be repeated. As a community procedure the children need not be retested, but if greater accuracy is desired they may be retested at the opening of school the following year. Immunized preschool children may be retested when entering school for the first time. Preschool and first grade children may receive the injections without a preliminary Dick test.

It is not considered necessary or advisable to attempt the immunization of persons beyond the grammar school age (in fact it is believed that as a community measure the procedure should be restricted to first grade children or younger) except when the occupation demands it, as, for example, student nurses. Since adults are more apt to react unfavorably to the nonspecific fraction of the precipitated toxin four doses are recommended (500, 2,000, 6,000, and 10,000 S. T. D.) but of the same volume and with the same interval between injections as with the three-dose method.

ACKNOWLEDGMENTS

The authors wish to express their appreciation of the enthusiastic cooperation of their associates, and also that of teachers and parents. They also wish to record the very considerable help given by Passed Assistant Surgeon J. W. Hornibrook.

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COURT DECISION ON PUBLIC HEALTH

Removal of garbage by city.—(Florida Supreme Court, Division B; *Clein* v. *Lee, City Manager et al.*, 200 So. 693; decided February 25, 1941.) The City of Miami, pursuant to authority, enacted an ordinance defining the term "garbage" and imposing a charge of $4 per annum on each family for its removal. The plaintiff, a resident of the city, refused to pay the charge and the city refused to remove his garbage. In a mandamus proceeding he sought to require the city to remove garbage from his premises but the supreme court affirmed the judgment of the lower court dismissing the proceeding. According to the appellate court the charge was not shown to be unreasonable and it was shown that 30,000 families in the city had complied with it. It was quite true, said the court, that the ordinance was a police measure and that the city was charged with the duty of protecting the health and sanitation of its people, but it could not perform this service and the other services which it was called upon to

perform without means to do so. Since the plaintiff had refused to pay the reasonable charge for the service, he had no ground for complaint.

DEATHS DURING WEEK ENDED APRIL 19, 1941

[From the Weekly Health Index, Issued by the Bureau of the Census, Department of Commerce]

	Week ended Apr. 19, 1941	Corresponding week, 1940
Data from 88 large cities of the United States:		
Total deaths	8,840	8,781
Average for 3 prior years	8,816	
Total deaths, first 16 weeks of year	149,653	149,771
Deaths per 1,000 population, first 16 weeks of year, annual rate	13.1	13.1
Deaths under 1 year of age	565	444
Average for 3 prior years	505	
Deaths under 1 year of age, first 16 weeks of year	8,604	8,198
Data from industrial insurance companies:		
Policies in force	64,570,519	65,744,323
Number of death claims	12,263	12,840
Death claims per 1,000 policies in force, annual rate	9.9	10.2
Death claims per 1,000 policies, first 16 weeks of year, annual rate	10.6	10.7

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED APRIL 26, 1941

Summary

The incidence of measles declined during the current week, with 50,609 cases reported as compared with 53,593 for the preceding week. A sharp increase was reported in Ohio, 7,182 cases as compared with 4,746 for the preceding week, but decreases were recorded in most of the other States. The highest current incidence, as indicated by case rates, continues to be reported from the Middle Atlantic, East North Central, and South Atlantic States.

A total of 62 cases of meningococcus meningitis was reported, the largest number for any corresponding week since 1937. Ten of these cases occurred in Virginia and 7 in Pennsylvania (2 in Luzerne County).

Of 16 cases of poliomyelitis, 3 were reported in Maryland, while only 3 other States reported more than 1 case each. A total of 405 cases has been reported to date this year (first 17 weeks), a larger number than was recorded for the corresponding period of each of the preceding 5 years with the exception of 1940 (414 cases). The South Atlantic States reported 103 of this total, 45 of which occurred in Florida.

For the current week, 3 cases of Rocky Mountain spotted fever were reported in Virginia, 1 case each in Delaware and South Dakota, and 13 cases in the Mountain States. To date this year 58 cases have been reported, most of which were in the Northwestern States, as compared with 31 cases in the corresponding period of 1940 and 42 in 1939.

For the current week, the incidence of diphtheria, scarlet fever, smallpox, and typhoid fever was below that for the corresponding period of each of the preceding 5 years.

Six cases of undulant fever were reported in Connecticut and 2 cases in Utah. Three cases of tularemia were reported in Utah and 1 case in Mississippi. Of 11 cases of endemic typhus fever, 4 occurred in Georgia and 1 in Massachusetts.

The death rate for the current week in 88 major cities in the United States was 11.6 per 1,000 population, as compared with 12.3 for the preceding week and a 3-year (1938–40) average of 11.9.

Telegraphic morbidity reports from State health officers for the week ended April 26, 1941, and comparison with corresponding week of 1940 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none were reported, cases may have occurred.

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended		Median, 1936–40	Week ended		Median, 1936–40	Week ended		Median, 1936–40	Week ended		Median, 1936–40
	Apr. 26, 1941	Apr. 27, 1940		Apr. 26, 1941	Apr. 27, 1940		Apr. 26, 1941	Apr. 27, 1940		Apr. 26, 1941	Apr. 27, 1940	
NEW ENG.												
Maine	1	0	0	-------	-------	6	84	597	72	0	1	1
New Hampshire	0	0	0	-------	-------	-------	49	15	31	0	0	0
Vermont	0	0	0	-------	-------	-------	84	6	78	0	0	0
Massachusetts [1]	3	3	4	-------	-------	-------	1,190	118	667	2	2	2
Rhode Island	3	3	0	-------	-------	-------	3	188	72	0	0	0
Connecticut	3	0	1	5	1	3	380	41	109	0	0	0
MID. ATL.												
New York	13	24	30	[2] 12	[2] 16	[2] 15	6,513	812	1,705	4	1	8
New Jersey	3	6	15	34	10	8	3,586	608	608	3	2	2
Pennsylvania	11	28	33	-------	-------	-------	5,789	330	1,014	7	12	9
E. NO. CEN.												
Ohio	8	7	17	12	54	27	7,182	25	209	1	1	3
Indiana	8	4	9	16	8	17	1,121	16	23	0	0	2
Illinois	17	19	35	12	9	41	2,812	104	104	3	3	3
Michigan [3]	0	2	8	14	14	6	3,581	674	420	0	0	2
Wisconsin	2	1	1	73	52	41	1,832	543	543	0	2	2
W. NO. CEN.												
Minnesota	3	0	2	4	-------	-------	47	120	212	0	0	0
Iowa	0	3	3	18	-------	6	213	436	187	0	0	0
Missouri	1	8	8	7	4	23	529	13	32	1	0	3
North Dakota	7	1	0	9	9	9	45	14	14	0	0	0
South Dakota [4]	0	0	0	1	2	-------	14	1	2	1	1	0
Nebraska	3	0	5	-------	-------	-------	15	17	35	0	0	0
Kansas	6	8	9	7	8	18	1,064	630	95	1	0	0
SO. ATL.												
Delaware [4]	0	0	0	-------	-------	-------	228	0	17	0	0	0
Maryland [3]	3	2	4	25	8	8	409	2	330	2	1	1
Dist. of Col	0	3	5	-------	-------	1	370	1	75	0	0	1
Virginia [4]	8	9	11	430	175	175	2,235	184	423	10	0	1
West Virginia [3]	2	14	10	13	55	55	889	15	76	1	3	4
North Carolina	19	4	7	12	14	17	1,590	135	321	2	0	2
South Carolina [1]	2	4	5	328	270	264	639	12	44	1	0	1
Georgia [1]	3	10	6	358	28	53	734	68	68	1	0	1
Florida	5	2	4	77	9	8	606	99	99	1	0	0
E. SO. CEN.												
Kentucky	5	4	9	5	42	18	1,482	86	310	2	0	2
Tennessee	3	4	4	60	64	64	650	127	90	2	0	2
Alabama [1]	10	5	9	39	93	93	993	176	176	3	2	3
Mississippi [3]	5	1	5	-------	-------	-------	-------	-------	-------	2	1	0
W. SO. CEN.												
Arkansas	3	4	6	96	92	92	479	30	30	1	0	1
Louisiana [1]	6	8	8	2	12	21	67	12	17	0	0	0
Oklahoma	2	2	2	76	85	85	184	21	62	2	3	1
Texas [1]	22	22	31	530	387	479	1,160	1,260	406	5	1	3
MOUNTAIN												
Montana [4]	3	1	2	19	4	10	30	40	40	1	0	0
Idaho	0	0	0	1	-------	2	23	37	37	0	0	0
Wyoming [4]	0	3	2	-------	1	-------	52	15	25	0	0	0
Colorado [4]	11	9	9	14	9	-------	445	26	38	0	0	0
New Mexico	1	1	2	1	-------	-------	214	30	42	0	0	0
Arizona	0	2	2	73	96	69	110	89	89	0	0	0
Utah [3]	1	1	1	7	10	-------	36	750	93	0	0	0
Nevada	0	-------	-------	-------	-------	-------	1	-------	-------	0	-------	-------
PACIFIC												
Washington	3	0	0	-------	-------	-------	103	792	327	0	0	0
Oregon	4	4	2	11	9	29	364	603	75	0	1	1
California [1]	18	11	25	272	68	74	383	397	812	3	0	1
Total	231	247	393	2,673	1,718	1,718	50,609	10,315	13,103	62	37	57
17 weeks	4,827	5,970	8,477	582,564	159,244	138,406	539,383	116,620	154,697	853	691	1,416

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended April 26, 1941, and comparison with corresponding week of 1940 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended		Median 1936–40	Week ended		Median 1936–40	Week ended		Median 1936–40	Week ended		Median 1936–40
	Apr. 26, 1941	Apr. 27, 1940		Apr. 26, 1941	Apr. 27, 1940		Apr. 26, 1941	Apr. 27, 1940		Apr. 26, 1941	Apr. 27, 1940	
NEW ENG.												
Maine	0	0	0	3	10	10	0	0	0	0	0	0
New Hampshire	0	0	0	1	2	4	0	0	0	0	0	1
Vermont	0	0	0	20	13	7	0	0	0	0	1	0
Massachusetts [1]	0	0	0	222	166	238	0	0	0	1	3	2
Rhode Island	0	0	0	6	6	19	0	0	0	0	0	0
Connecticut	0	0	0	74	119	107	0	0	0	2	3	1
MID. ATL.												
New York	0	2	0	433	977	834	0	0	0	7	9	9
New Jersey	0	0	0	267	396	246	0	0	0	0	6	3
Pennsylvania	1	1	1	393	476	476	0	0	0	7	7	7
E. NO. CEN.												
Ohio	1	1	1	261	505	442	0	0	0	1	3	6
Indiana	0	0	0	118	217	177	0	3	10	0	1	1
Illinois	0	0	1	313	818	725	1	3	19	1	11	4
Michigan [2]	[2]0	3	0	250	326	412	0	4	5	1	4	4
Wisconsin	1	0	0	114	97	185	14	2	5	0	4	2
W. NO. CEN.												
Minnesota	0	0	0	38	72	160	3	3	5	1	1	0
Iowa	0	0	0	50	66	166	6	26	40	2	1	1
Missouri	0	0	0	98	37	161	3	8	18	0	1	2
North Dakota	0	0	0	2	13	14	0	3	8	0	0	0
South Dakota [4]	0	0	0	18	14	15	0	0	7	0	0	0
Nebraska	0	0	0	15	19	39	0	0	14	0	0	0
Kansas	0	0	0	33	75	105	0	0	13	0	1	1
SO. ATL.												
Delaware [4]	0	0	0	38	11	6	0	0	0	0	0	0
Maryland [3]	3	0	0	40	32	48	0	0	0	0	2	1
Dist. of Col	0	0	0	8	30	18	0	0	0	1	0	0
Virginia [4]	1	0	0	31	33	30	0	0	0	3	0	5
West Virginia [3]	0	0	0	34	52	41	0	0	0	4	0	2
North Carolina	0	0	0	26	32	28	0	1	1	3	0	2
South Carolina [1]	0	0	1	1	2	2	0	0	0	2	2	4
Georgia [1]	0	0	0	18	6	6	0	0	0	1	3	3
Florida	2	0	0	6	7	6	0	1	0	1	0	2
E. SO. CEN.												
Kentucky	0	0	0	87	83	42	0	1	1	4	2	3
Tennessee	0	0	0	65	74	28	0	0	0	2	0	2
Alabama [1]	2	0	1	17	12	6	0	1	2	1	4	4
Mississippi [3]	0	1	0	7	9	4	2	0	0	5	0	2
W. SO. CEN.												
Arkansas	0	0	0	7	5	6	1	3	4	1	0	1
Louisiana [1]	[2]0	0	1	5	5	9	1	0	0	8	6	6
Oklahoma	0	0	0	8	12	24	0	1	3	0	0	4
Texas [1]	1	2	0	102	26	39	3	6	6	6	5	8
MOUNTAIN												
Montana [4]	2	0	0	42	29	29	1	0	4	0	1	1
Idaho	0	0	0	11	7	9	0	0	5	0	1	1
Wyoming [4]	0	0	0	12	8	7	0	0	1	0	1	0
Colorado [4]	0	0	0	20	44	58	0	1	1	1	0	0
New Mexico	0	0	0	5	23	23	0	1	0	0	1	1
Arizona	0	0	0	12	6	13	0	0	0	1	1	1
Utah [3]	0	0	0	10	13	26	0	2	1	0	0	0
Nevada	0	----	----	0	----	----	0	----	----	0	----	----
PACIFIC												
Washington	1	0	0	15	41	35	2	0	10	0	0	2
Oregon	0	0	0	13	11	31	9	0	16	0	1	1
California [1]	1	3	3	145	133	170	0	6	17	9	5	6
Total	16	13	16	3,514	5,170	5,170	46	76	363	76	91	117
17 weeks	405	414	347	63,239	81,757	100,393	752	1,237	5,485	1,282	1,346	1,880

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended April 26, 1941, and comparison with corresponding week of 1940—Continued

Division and State	Whooping cough	
	Week ended	
	Apr. 26, 1941	Apr. 27, 1940
NEW ENG.		
Maine	19	16
New Hampshire	0	40
Vermont	14	0
Massachusetts [1]	215	150
Rhode Island	20	9
Connecticut	73	32
MID. ATL.		
New York	348	332
New Jersey	103	113
Pennsylvania	375	215
E. NO. CEN.		
Ohio	365	257
Indiana	39	37
Illinois	72	114
Michigan [3]	318	196
Wisconsin	119	80
W. NO. CEN.		
Minnesota	121	41
Iowa	39	29
Missouri	59	4
North Dakota	23	16
South Dakota [4]	17	0
Nebraska	24	3
Kansas	116	43
SO. ATL.		
Delaware [4]	8	5
Maryland [3]	112	140
Dist. of Col	22	22
Virginia [4]	131	31
West Virginia [3]	54	35
North Carolina	349	76
South Carolina [1]	171	20
Georgia [1]	28	5
Florida	23	32
E. SO. CEN.		
Kentucky	95	84
Tennessee	55	32
Alabama [1]	107	18
Mississippi [3]	------	------
W. SO. CEN.		
Arkansas	38	33
Louisiana [1]	8	63
Oklahoma	37	9
Texas [1]	229	318
MOUNTAIN		
Montana [4]	16	4
Idaho	9	7
Wyoming	3	0
Colorado	191	16
New Mexico	26	144
Arizona	34	31
Utah [3]	55	134
Nevada	0	------
PACIFIC		
Washington	145	81
Oregon	28	20
California [1]	683	455
Total	5,136	3,542
17 weeks	74,833	51,872

[1] Typhus fever, week ended April 26, 1941, 11 cases, as follows: Massachusetts, 1; South Carolina, 1; Georgia, 4; Alabama, 1; Louisiana, 1; Texas, 2; California, 1.

[2] New York City only.

[3] Period ended earlier than Saturday.

[4] Rocky Mountain spotted fever, week ended April 26, 1941, 18 cases as follows: South Dakota, 1; Delaware, 1; Virginia, 3; Montana, 9; Wyoming, 3; Colorado, 1.

[5] One case of poliomyelitis reported in Michigan for the week ended March 29, 1941, and 2 cases in Louisiana for the succeeding week, although not listed in the tables as in those States, were included in the totals published for the two weeks, 20 and 21 cases respectively (Public Health Reports, April 4, p. 744, and April 11, p. 808).

WEEKLY REPORTS FROM CITIES

City reports for week ended April 12, 1941

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	115	266	78	5,419	698	2,104	22	394	20	1,210	------
Current week [1]	61	141	42	16,773	415	1,592	2	350	13	1,155	------
Maine:											
Portland	0	------	0	2	7	1	0	0	0	16	29
New Hampshire:											
Concord	0	------	0	0	0	1	0	1	0	0	12
Manchester	0	------	0	0	0	3	0	0	0	0	17
Nashua	0	------	0	0	0	0	0	0	0	1	8
Vermont:											
Barre	0	------	0	0	0	0	0	0	0	0	2
Burlington	0	------	0	5	0	0	0	0	0	0	8
Rutland	0	------	0	0	0	1	0	0	0	0	10
Massachusetts:											
Boston	2	------	0	403	15	83	0	13	0	51	206
Fall River	0	------	0	0	3	6	0	0	0	1	29
Springfield	3	------	0	8	0	21	0	2	0	1	32
Worcester	0	------	0	42	7	12	0	1	0	10	54
Rhode Island:											
Pawtucket	0	------	0	0	0	1	0	0	0	2	16
Providence	0	1	1	2	2	4	0	2	0	12	73
Connecticut:											
Bridgeport	0	1	1	6	3	8	0	1	0	1	35
Hartford	1	------	0	1	2	4	0	1	0	3	26
New Haven	0	------	0	1	2	11	0	0	0	0	45
New York:											
Buffalo	0	------	0	107	6	48	0	6	0	10	140
New York	18	18	4	5,579	68	378	0	81	1	74	1,493
Rochester	0	------	0	237	4	1	0	0	0	21	67
Syracuse	0	------	0	0	0	3	0	0	0	5	50
New Jersey:											
Camden	0	------	0	10	5	16	0	0	0	1	24
Newark	0	4	0	186	3	41	0	3	0	14	84
Trenton	0	------	0	60	0	33	0	2	0	0	39
Pennsylvania:											
Philadelphia	1	5	3	1,256	22	102	0	26	1	31	423
Pittsburgh	2	3	2	645	7	22	0	5	0	55	152
Reading	0	------	0	97	2	5	0	0	0	2	18
Scranton	0	------	------	13	------	1	0	------	0	0	------
Ohio:											
Cincinnati	1	------	0	367	3	15	0	6	0	8	133
Cleveland	1	4	0	1,141	8	31	0	16	0	71	193
Columbus	0	1	1	269	3	27	0	3	0	14	83
Toledo	0	------	0	72	4	6	0	2	0	17	80
Indiana:											
Anderson	0	------	1	3	1	1	0	0	0	0	14
Fort Wayne	0	------	0	60	1	1	0	0	0	0	19
Indianapolis	2	------	1	450	10	12	0	3	0	3	108
Muncie	0	------	0	60	1	17	0	0	0	2	10
South Bend	0	------	0	0	0	0	0	0	0	0	22
Terre Haute	1	------	1	2	0	2	0	0	0	0	21
Illinois:											
Alton	0	------	0	0	1	1	0	3	0	4	8
Chicago	7	3	2	1,389	28	196	0	32	1	28	696
Elgin	0	------	0	180	0	0	0	0	0	0	15
Moline	0	------	0	32	0	2	0	0	0	0	8
Springfield	0	3	0	5	1	7	0	0	0	0	19
Michigan:											
Detroit	2	2	1	969	15	171	0	13	0	129	277
Flint	0	------	0	166	4	3	0	1	0	7	33
Grand Rapids	0	------	0	461	2	8	0	1	0	3	34
Wisconsin:											
Kenosha	0	------	0	203	0	0	0	0	0	0	7
Madison	0	------	0	59	0	14	0	0	0	1	7
Milwaukee	0	------	0	352	2	19	0	2	0	29	80
Racine	0	------	0	54	0	4	0	0	0	4	12
Superior	0	------	0	0	0	3	0	0	0	0	6

[1] Figures for Tampa and Boise estimated; reports not received.

City reports for week ended April 12, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Minnesota:											
Duluth	0	----	0	1	1	0	0	0	0	22	17
Minneapolis	0	----	0	2	3	15	0	0	0	18	75
St. Paul	0	1	1	1	7	10	0	1	0	13	65
Iowa:											
Cedar Rapids	0	----	----	9	----	1	0	----	0	0	----
Davenport	0	----	----	10	----	1	0	----	0	0	----
Des Moines	0	----	----	13	----	7	0	----	0	0	30
Sioux City	0	----	----	2	----	0	0	----	0	2	----
Waterloo	0	----	----	36	----	1	0	----	0	2	----
Missouri:											
Kansas City	0	----	1	55	8	5	0	4	0	24	107
St. Joseph	0	----	0	18	7	0	0	1	0	0	26
St. Louis	0	----	0	295	10	89	0	4	1	30	174
North Dakota:											
Fargo	0	----	0	2	1	0	0	0	0	23	7
Grand Forks	0	----	----	0	----	0	0	----	0	0	----
Minot	0	----	----	1	----	0	0	----	0	0	3
South Dakota:											
Aberdeen	0	----	----	0	----	1	0	----	0	0	----
Sioux Falls	0	----	----	0	----	2	0	----	0	0	6
Nebraska:											
Lincoln	0	----	----	0	----	4	0	----	0	1	----
Omaha	0	----	0	2	4	5	1	3	0	2	58
Kansas:											
Lawrence	0	----	0	26	0	1	0	0	0	6	6
Topeka	0	----	0	237	1	0	0	0	0	7	9
Wichita	1	2	0	4	3	1	0	0	0	10	41
Delaware:											
Wilmington	0	----	0	49	3	14	0	0	0	2	30
Maryland:											
Baltimore	1	4	0	108	30	19	0	10	0	56	262
Cumberland	0	----	1	1	0	0	0	0	0	1	17
Frederick	0	----	0	1	0	2	0	0	0	3	5
Dist. of Col.:											
Washington	0	1	1	341	13	18	0	12	3	18	159
Virginia:											
Lynchburg	0	----	0	1	3	0	0	3	0	1	14
Norfolk	0	----	0	194	3	1	0	1	0	7	28
Richmond	0	----	0	77	6	2	0	3	0	0	48
Roanoke	0	----	1	72	1	1	0	0	0	3	16
West Virginia:											
Charleston	1	1	1	2	7	1	0	0	0	0	27
Huntington	2	----	----	78	----	0	0	----	0	3	----
Wheeling	0	----	0	14	2	0	0	0	0	1	21
North Carolina:											
Gastonia	0	----	0	24	0	0	0	0	0	10	----
Raleigh	0	----	0	162	3	0	0	1	0	33	17
Wilmington	0	----	0	2	2	0	0	1	0	7	16
Winston-Salem	0	----	0	23	2	1	0	1	0	2	15
South Carolina:											
Charleston	0	22	0	37	3	0	0	3	1	3	25
Florence	0	7	0	12	1	0	0	0	0	4	10
Greenville	0	----	0	60	3	0	0	0	0	10	10
Georgia:											
Atlanta	1	1	0	18	4	0	0	4	0	3	86
Brunswick	0	----	0	51	0	0	0	0	0	0	7
Savannah	1	10	2	26	3	5	0	1	1	0	32
Florida:											
Miami	0	2	1	20	1	0	0	0	0	4	48
St. Petersburg	0	----	0	88	1	0	0	2	0	0	29
Tampa	----	----	----	----	----	----	----	----	----	----	----
Kentucky:											
Ashland	0	----	1	2	0	0	0	0	0	2	8
Covington	0	----	0	0	1	0	0	2	0	0	17
Lexington	0	----	0	3	2	0	0	1	0	3	18
Louisville	0	----	0	849	3	80	0	6	0	9	81
Tennessee:											
Knoxville	0	----	0	106	1	12	0	1	0	8	29
Memphis	0	----	3	95	3	4	0	3	0	7	80
Nashville	0	----	1	88	2	5	0	1	0	9	55
Alabama:											
Birmingham	0	2	1	32	2	3	0	5	1	0	74
Mobile	0	4	3	3	0	0	0	0	0	0	27
Montgomery	0	1	----	28	----	0	0	----	0	0	----

City reports for week ended April 12, 1941—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Arkansas:											
Fort Smith	0	1		2		1	0		0	0	
Little Rock	0	12	1	14	0	2	0	3	0	1	19
Louisiana:											
New Orleans	0	2	1	39	12	2	1	7	0	8	135
Shreveport	1		0	1	4	0	0	1	0	0	42
Oklahoma:											
Oklahoma City	0	4	1	5	2	4	0	2	0	0	41
Tulsa	0		0	67	3	1	0	1	0	19	25
Texas:											
Dallas	4	1	1	36	4	9	0	3	0	1	72
Fort Worth	2		0	75	2	5	0	1	0	1	38
Galveston	0		0	2	1	1	0	1	0	0	13
Houston	1		0	0	5	0	0	4	1	0	68
San Antonio	1	2	3	0	0	1	0	10	0	0	70
Montana:											
Billings	0		0	1	0	0	0	0	0	0	8
Great Falls	1		0	4	0	2	0	0	0	0	13
Helena	0		0	1	0	4	0	0	0	0	2
Missoula	0		0	0	0	1	0	0	0	0	3
Idaho:											
Boise											
Colorado:											
Colorado Springs	0		0	1	0	4	0	0	0	4	8
Denver	3	11	0	258	2	8	0	3	0	81	82
Pueblo	0		0	2	0	1	0	0	0	24	8
New Mexico:											
Albuquerque	0		0	6	3	1	0	0	0	0	11
Utah:											
Salt Lake City	0		0	4	0	3	0	0	0	11	30
Washington:											
Seattle	0		0	0	1	4	0	5	0	6	94
Spokane	0		0	12	2	1	0	0	0	0	43
Tacoma	0		0	0	1	0	0	0	1	6	35
Oregon:											
Portland	1	3	0	18	2	4	0	2	0	2	72
Salem	0		0	1	0	0	0	0	0	0	
California:											
Los Angeles	0	12	2	44	6	47	0	22	0	41	390
Sacramento	1		0	2	1	5	0	3	0	7	27
San Francisco	2	7	0	0	5	1	0	5	1	58	170

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Massachusetts:				Maryland:			
Boston	2	0	0	Baltimore	2	1	1
New York:				Florida:			
New York	3	2	0	Miami	0	0	5
Pennsylvania:				Tennessee:			
Philadelphia	1	0	0	Memphis	0	1	0
Ohio:				Oklahoma:			
Cleveland	1	0	0	Tulsa	1	0	0
Michigan:							
Detroit	2	0	0				

Encephalitis, epidemic or lethargic.—Cases: New York, 3; Topeka, 1. Deaths: New York, 2; Springfield, Ill., 2; Topeka, 1.

Pellagra.—Cases: Chicago, 1; Charleston, S. C., 4; Savannah, 2; New Orleans, 1.

Typhus fever.—Cases: Baltimore, 1; Atlanta, 1; Savannah, 1; Montgomery, 1; Houston, 1.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended March 22, 1941.—During the week ended March 22, 1941, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis		13	2	7	12	4	3	1	3	45
Chickenpox		3	2	195	301	52	15	15	54	637
Diphtheria	8	12		14	1	3	2			40
Influenza		38			9	1			13	61
Lethargic encephalitis					1					1
Measles		176	73	292	1,390	107	264	272	1,136	3,710
Mumps				346	286	36	35	16	25	744
Pneumonia		22			12	2			6	42
Scarlet fever		26	6	82	209	10	2	27	11	373
Smallpox							1			1
Tuberculosis	5	20	8	45	60	3	7			148
Typhoid and paratyphoid fever			2	29	2			2		35
Whooping cough				162	189	2	2	4	25	384

GREAT BRITAIN

England and Wales—Infectious diseases—13 weeks ended September 28, 1940.—During the 13 weeks ended September 28, 1940, cases of certain infectious diseases were reported in England and Wales as follows:

Disease	Cases	Disease	Cases
Diphtheria	11,225	Puerperal pyrexia	1,891
Dysentery	613	Scarlet fever	17,737
Ophthalmia neonatorum	1,252	Typhoid and paratyphoid fever	1,418
Pneumonia	5,539		

England and Wales—Vital statistics—Third quarter 1940.—The following vital statistics for the third quarter of 1940 for England and Wales are taken from the Quarterly Return of Births, Deaths, and Marriages, issued by the Registrar General and are provisional:

	Number	Annual rate per 1,000 population		Number	Annual rate per 1,000 population
Live births	149,249	14.3	Deaths from—Continued.		
Stillbirths	5,354	.51	Influenza	269	0.03
Deaths, all causes	108,880	10.9	Measles	169	.02
Deaths under 1 year of age	6,316	[1] 42	Scarlet fever	39	.00
Deaths from:			Typhoid and paratyphoid fever	39	.00
Diarrhea and enteritis (under 2 years of age)	718	4.8	Whooping cough	116	.01
Diphtheria	559	.06			

[1] Per 1,000 live births.

NOTE.—The above deaths include only civilians.

SWITZERLAND

Notifiable diseases—January 1941.—During the month of January 1941, cases of certain notifiable diseases were reported in Switzerland as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	40	Paratyphoid fever	5
Chickenpox	189	Poliomyelitis	11
Diphtheria and croup	109	Scarlet fever	357
German measles	36	Tuberculosis	254
Influenza	227	Typhoid fever	5
Lethargic encephalitis	1	Undulant fever	5
Measles	412	Whooping cough	184
Mumps	110		

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—A cumulative table giving current information regarding the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS of April 25, 1941, pages 924-928. A similar table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Plague

Thailand—Lampang Province.—During the week ended April 5, 1941, 1 fatal case of plague was reported in Lampang Province, Thailand.

Typhus Fever

Switzerland—Zurich.—During the week ended March 22, 1941, 1 case of typhus fever was reported in Zurich, Switzerland.

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